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Organic Aquaculture

AFSIC Notes #5

Compiled by:
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Alternative Farming Systems Information Center
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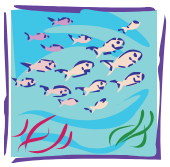

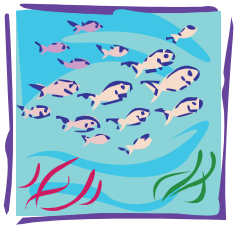

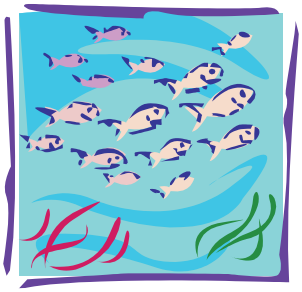

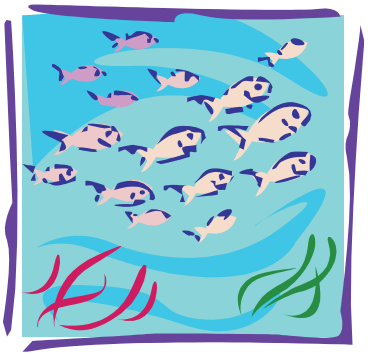

The creation of this document was prompted by many customer requests for information on the topic. Text and citations were compiled by Alternative Farming Systems Information Center (AFSIC) staff members Stephanie Boehmer, Mary Gold, Stephanie Hauser, Bill Thomas, and Ann Young. The authors wish to thank Becky Thompson for her work on editing and layout. This publication is available in print format on request to AFSIC or electronically at the AFSIC Web site, http://www.nal.usda.gov/afsic/.

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Introduction

Diminishing fishery harvests, wild fish food-safety issues, environmental concerns, increased fish consumption, and the increasing market share of organic foods have combined to focus attention on "organic aquaculture." Consumer demand may well drive the organic production of finfish, shellfish, and other aquatic species into the mainstream during the next decade.

Organic aquaculture has attracted the attention of researchers from several academic disciplines as well as that of environmental advocates and entrepreneurial innovators. A small number of "certified" and non-certified organic fish and microalgae products have made it to the retail market place. While the regulatory specifics still need to be addressed, this new organic market niche has significant potential for growth in the future.

This publication briefly identifies and describes the important issues pertaining to organic aquaculture with regard to production technology, standards and laws, environmental and economic sustainability, research and development, and markets and trade. Presently, there are many contradictions and unresolved questions facing the organic aquaculture production and market sector. The authors have worked to present a snapshot of the situation today with the intention of providing an unbiased and neutral contribution to the dialog of discovery on this issue.

The information covered in this document – organic production in aquaculture; the current status of U.S. standards; the National Organic Standards Board Aquatic Animal Task Force; international organic aquaculture standards; marketing outlook and consumer trends; and research and development in organic aquaculture – is current and up-to-date as of December 2004. Background information pertaining to organic agricultural production and to conventional aquaculture is included in order to provide context for developments in organic aquaculture. This document highlights references to print and electronic documentation chosen from representative sources. Referenced sources are indicated by abbreviated citations within the text; the complete citations and additional sources are found with the Selected Readings list at the end the section. A detailed companion bibliography is included at the end of this publication.

Selected Readings

The Future of Fish: Issues and Trends to 2020, by Christopher L. Delgado, Nikolas Wada, Mark W. Rosegrant, and Mahfuzuddin Ahmed. Washington, DC; Penang, Malaysia: International Food Policy Research Institute (IFPRI); WorldFish Center, 2003.
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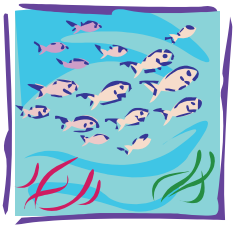


Organic Production in Aquaculture

Defining "organic aquaculture" is very much a work-in-progress and, for many reasons, an endeavor marked by controversy. Members of both the organic and the aquaculture communities disagree on how, or even if, aquatic animal and plant production systems can qualify as "organic" as the term is commonly used. Any potential definition must be a multi-faceted one. "Organic" in the context of food production connotes standards and certification – a verifiable claim for the production process and production practices – as well as more elusive characteristics such as consumer expectation for food quality and safety and general environmental, social, and economic benefits for farmers and for society. The variety of species produced in aquacultural systems and vast differences in cultural requirements for finfish, shellfish, mollusks, and aquatic plants add to the complexity of defining this sector. Some species and some production systems may prove quite difficult to adapt to a traditional "organic" system. [See the *Conventional Aquaculture* section in this document for detail about existing production systems.]

Traditional organic farming systems "rely on ecologically based practices, such as cultural and biological pest management, and virtually exclude the use of synthetic chemicals in crop production and prohibit the use of antibiotics and hormones in livestock production." [*Briefing Room: Organic Farming and Marketing*, 2004] Sustainability, environmental stewardship, and holistic, integrated approaches to production are hallmarks of organic systems. Standards for organic cropping and terrestrial livestock husbandry practices have existed for decades. In recent years, standards have been incorporated into state and national organic rule making and certification requirements. [See *Organic Agriculture* background section in this document for detail about agricultural practices and standards.]

(Continued on page 4)

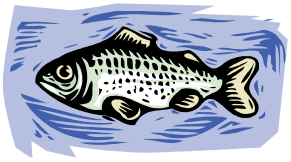
Organic Production in Aquaculture (continued)

(Continued from page 3)

Interpreting practices and standards developed for terrestrial species into practices and standards relevant to aquatic species, both animal and plant, remains a major challenge for organic aquaculture. How can aquatic operations comply with the requirements for an organic system plan, for obtaining acceptable stock, for implementing health care monitoring and management, for maintaining prescribed "living conditions," for development and acceptance of allowed and prohibited substances lists, for organic feed requirements, for controlled post-harvest processing, for nutrient management, and for required animal identification and record-keeping?

Many specialists agree that the most immediate deterrent to production of organic animals is the issue of providing organically produced feed, especially for species requiring significant proportions of animal-based protein. Where will it come from? Can wild-caught fish and fish by-products be utilized as organic feed stock for farmed species? Should emphasis be placed on farming low-trophic species?

Today, organic aquaculture production takes place primarily in Europe, where certified organic salmon, carp, and trout are grown and sold. Certified organic mussels, Tiger shrimp, white shrimp, and tilapia also are cultured in such diverse places as Vietnam, Peru, Ecuador, Chile, New Zealand, and Israel. Standards and certification procedures are set by just a few certification agencies.



Universal acceptance of any standards does not currently exist. [See the *International Organic Aquaculture Standards* section in this document for detail.] To risk investment in this sector, producers require formally recognized standards in order to communicate the advantages of organic aquaculture products to consumers. The key to the continued growth and development of organic aquaculture lies in resolving a number of issues that currently stand in the way of instituting internationally accepted certification standards.

Other points of discussion:

- Criteria for evaluating the suitability of a production site for an organic aquaculture operation; specifically, how standards will be developed for the site of production to address nutrient concentration/effluent management and water testing parameters, chemical drift, the emergence and transfer of disease, the escape of captive species to the wild, biodiversity, and detrimental impacts on indigenous species;
- Guidelines to control practices used in aquaculture operations that are consistent with organic principles, especially with regard to chemicals administered to control diseases and parasites, and to accommodating "natural behavior" and animal welfare in closed systems;
- Induction of triploidy in fish species;
- Origin of livestock requirement for aquaculture operations that obtain stock or fry from wild populations;
- Status of "wild caught" fish and related by-products;
- Conversion requirements for producers wishing to change over to an organic system;
- Recordkeeping/traceability elements, and inspection practices pertinent to aquatic species; and
- Harmonization of organic aquaculture standards between countries.

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Further Comments of the Organic Trade Association (OTA) for the USDA-AMS-NOP Hearings on Organic Production and Handling of Aquatic Animals to be Labeled as Organic, by Tom Hutcheson. Federal Register Docket Number TM-00-03. May 3, 2000.
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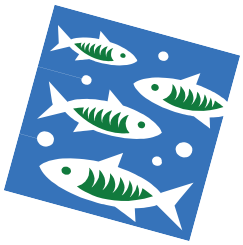
Current Status of U.S. Standards for Organic Aquaculture

As of the writing of this document, the legal status of using the organic label in the United States for aquatic species, and the future of developing U.S. Department of Agriculture (USDA) certification standards for organic aquacultural products and aquatic species, are under review. USDA and National Organic Program (NOP) staff, and National Organic Standards Board (NOSB) members are currently studying the legal and rule-making latitude granted USDA in terms of several commodity areas including fish, both farmed and wild-caught.

The Organic Foods Production Act of 1990 (OFPA), from which current USDA standards were derived, addressed "aquatic species" in its definition of livestock: "The term 'livestock' means any cattle, sheep, goats, swine, poultry, equine animals used for food or in the production of food, fish used for food, wild or domesticated game, or other non-plant life." [*Organic Foods Production Act of 1990*, 6502 Definitions] However, the Final Rule, as issued, did not present specific standards for the production and labeling of aquatic species or for aquaculture operations. Recognizing the lack of commonly accepted certification programs for aquatic operations, including aquaculture, and the limited models on which to base national standards, NOP staff made the decision to delay presenting standards for selected commodities, including aquatic species, until a later date.



The Final Rule, under the heading "Additional NOP Standards for Specific Production Categories," states: "Many commenters asked that the NOP include in the final rule certification standards for apiculture, greenhouses, mushrooms, aquatic species, culinary herbs, pet food, and minor animal species (e.g., rabbits) food. The NOP intends to provide standards for categories where the Act provides the authority to promulgate standards. During the 18-month implementation period, the NOP intends to publish for comment certification standards for apiculture, mushrooms, greenhouses and aquatic animals. These standards will build upon the existing final rule and will address only the unique requirements necessary to certify these specialized operations." [*Federal Register*, p. 80556-57]

Certain aquatic species and harvesting systems fall under OFPA and NOP guidance pertaining to wild-crop harvesting. "Wild-crop producers must comply with the same organic system plan requirements and conditions, as applicable to their operation, as their counterparts who produce crops and livestock. Wild harvest operations are production systems, and they must satisfy the general requirement that all practices included in their organic system plan must maintain or improve the natural resources of the operation, including soil and water quality. We modified the practice standard to emphasize that wild harvest production is linked to a designated site and expect that a certifying agent would incorporate mapping and boundary conditions into the organic system plan requirements. Finally, we changed the definition of 'wild crop' to specify that harvest takes place from a 'site' instead of 'from land,' thereby allowing for aquatic plant certification." [*Federal Register*, p. 80566]

Selected Readings

Applying Organic Principles to Aquaculture Systems: Understanding Proposed Organic Certification Standards for Farmed Salmon: Market Trends in Aquaculture, by Nathan Pelletier. June 2003.
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National Organic Standards Board (NOSB) Aquatic Animal Task Force

"The Organic Foods Production Act of 1990 (OFPA), part of the 1990 Farm Bill, authorized the Secretary of Agriculture to appoint a 15-member National Organic Standards Board (NOSB). The board's main mission is to assist the Secretary in developing standards for substances to be used in organic production. The NOSB also advises the Secretary on other aspects of implementing the national organic program." Recommendations made by the NOSB are not official policy until they are approved and adopted by U.S. Department of Agriculture (USDA). [*National Organic Standards Board* Web site, 2004]

In September 2000, the NOSB named six of its members to an Aquatic Animal Task Force "to evaluate aquaculture and wild capture aquatic animal operations and to assess the feasibility of developing organic production and handling standards for their certification." [*NOSB Task Force Recommendations*, May 2001]

The Task Force compiled a report of recommendations which covered issues related to organically produced aquatic animals in general, and aquaculture specifically. Subtopics included "origin of livestock," "livestock feed," "health care management," "livestock living conditions," and "identification and record keeping." In October 2001, the NOSB accepted the report and unanimously approved the following recommendations:

- Standards be developed for the production of farmed aquatic animals that reflect an innovative approach to organic certification while remaining fully consistent with the statutory requirements of the Organic Foods Production Act
- If standards are developed for farmed aquatic animals, we recommend that the National Organic Program and the National Organic Standards Board use the Aquatic Animal Task Force report as guidance.
- No standards be developed for wild caught aquatic animals

[*NOSB Draft Meeting Minutes*, October 17, 2001]

From the time the Final Recommendations of the Task Force were approved by the NOSB in October 2001, the National Organic Program (NOP) has struggled to define their scope of enforcement for the certification of nontraditional products including aquatic species. In a Directive dated April 13, 2004, the NOP stated, "Although OFPA provided coverage for organic aquatic animal standards, NOP has not developed any standards for proposal to the public for comment." [National Organic Program Scope, September 28, 2004] Additionally, in the period since 2001, a rider to the Emergency Wartime Supplemental Appropriations Act regarding organic standards for wild seafood was passed in April 2003; "Notwithstanding the requirement of section 2107(a)(1)(A) requiring products to be produced only on certified organic farms, the Secretary shall allow, through regulations promulgated after public notice and opportunity for comment, wild seafood to be certified or labeled as organic."

In October 2004, the Livestock Committee of the NOSB recommended the establishment of a new task force on aquatic animals to provide guidance for the creation of aquatic animal standards. This Task Force will be comprised of two working groups; one for wild-caught and one for farmed aquatic species. The Task Force responsibilities will be two-fold:

1) After consideration of the 2001 Aquatic Animals Task Force report, recommend to the NOSB whether organic standards for wild caught and farmed aquatic animals should be developed at the present time, and if so, the scope of the standards.
2) If standards should be developed at the present time, recommend draft standards to the NOSB.

[Formation of a Task Force on Standards for Aquatic Animals, October 2004]

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International Organic Aquaculture Standards

Several countries and international organizations have addressed or mandated standards for organic aquaculture. In the 2002 Food and Agriculture Organization (FAO) of the United Nations document, *Organic Agriculture, Environment and Food Security*, Tacon and Brister cite the range of international organic aquacultural standards. "Despite its late start and modest size, the organic aquaculture sector currently boasts 20-25 private and non-private certifying bodies...They have a diverse set of aquaculture standards which sometimes vary considerably from country to country, certifier to certifier, and species to species." Although this summary is presented by the FAO, the FAO's food standards body, the Codex Alimentarius Commission, has not yet made recommendations for aquaculture in its provisions for organic livestock. Thus, while some international standards may be used to help formulate U.S. organic aquaculture standards, no one standard is definitive.

The International Federation of Organic Agriculture Movements (IFOAM) is another international body that is attempting to create guidelines that will normalize organic production and certification worldwide. "IFOAM's Organic Guarantee System unites the organic world through a common system of standards, verification, and market identity. It is the practical realization of IFOAM's commitment to harmonize an international guarantee of organic integrity." Through its IFOAM Norms document which is comprised of the IFOAM Basic Standards for Organic Production and Processing (IBS) and the IFOAM Accreditation Criteria for Bodies Certifying Organic Production and Processing (IAC); and its international membership of certification bodies, IFOAM's guidelines for aquaculture, currently in draft form, will impact organic certification organizations worldwide.

Selected Readings

Applying Organic Principles to Aquaculture Systems: Understanding Proposed Organic Certification Standards for Farmed Salmon: Market Trends in Aquaculture, by Nathan Pelletier. June 2003.
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(Continued on page 8)

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(Continued from page 7)

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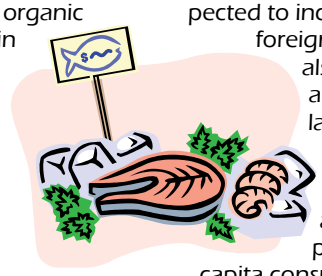
Market Outlook and Consumer Trends

Consumer and market studies confirm a growing demand for both organic food products and for fish and related food products coming from convention aquaculture. Despite the unresolved status of the certification and labeling of organic aquatic animals and plants in the U.S., the parallel successes of both the organic livestock and conventional aquaculture markets have encouraged producers involved in both sectors to explore niche markets for organic aquacultural products. There are documented trends in the growth of other organic livestock sectors, and in the sales of "natural," hormone-free, and antibiotic-free fish and shellfish. This increasing demand has started to drive producer and retail interest in aquacultural products that have a "certified organic" label. "Burgeoning consumer interest in organically grown foods has opened new market opportunities for producers and is leading to a transformation in the organic foods industry," summarizes a current U.S. Department of Agriculture (USDA) Economic Research Service (ERS) report. It further clarifies the organic market situation, "Once a niche product sold in a limited number of retail outlets, organic foods are currently sold in a wide variety of venues including farmers markets, natural product supermarkets, conventional supermarkets, and club stores. Many U.S. manufacturers and distributors are specializing in processing and marketing organic products, while some longtime manufacturers of conventional products have introduced organic items to their product lines. As a result, an ever-widening array of organic agricultural and food products is now available." [Dimitri and Greene, 2002, p. 1]



U.S. aquaculture is also a growing sector of the agricultural market, although experiencing considerable international competition. Recent ERS reports have supported this point. In the October 2003 USDA *Aquaculture Outlook*, author David Harvey observed that "Although beset with questions about the production of aquatic species, aquaculture is expected to continue to grow as a source of fish, shellfish, and mollusks. The potential for aquaculture production to expand and compete with wild-harvest seafood and other livestock products is readily evident in the continued growth in imported aquaculture products." Additionally, in the subsequent *Aquaculture Outlook*, Harvey reported "With a stronger domestic economy and higher prices for livestock and poultry products, domestic aquacultural production is expected to increase in 2004....Imports of foreign aquacultural products are also expected to expand, but at a slower rate than seen over the last several years."

Consumer demand for fish will also play a role in the future of aquaculture. ERS projections point to not only increased per capita consumption of fish in the U.S., but to growth in the number of older Americans, who traditionally eat more fish than younger people. "Fish and fruits are predicted to lead the increase in total consumption, with about 30-percent growth over the next two decades." [Biing-Hwan, 2003]

In a Food and Agriculture Organization (FAO) report from 2002, Brister and Tacon attempt to approximate the current international production for organic aquaculture. "Although no official statistical data are available concerning the global production of certified organic aquaculture products, it is estimated that total production in 2000 was only about 5,000 metric tonnes, primarily from European countries." Later in the report this estimate is used to chart potential future production, "Based on current estimates of certified organic aquaculture production and an anticipated compound annual growth rate of 30 percent from 2001 to 2010, 20 percent from 2011 to 2020, and 10 percent from 2021 to 2030, it is estimated that production will increase 240-fold from 5,000 tonnes in 2000 to 1.2 [million] tonnes by 2030. Such a production of certified aquatic products would be equivalent to 0.6 percent of the total estimated aquaculture production in 2030." This analysis parallels the outlook for organic and aquacultural production in the U.S. and may encourage U.S. producers to enter this market.

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Research and Development

Aquatic species, both animal and plant; ecological situations and locations; and various production systems, both marine and freshwater; are now under scrutiny in order to determine adaptability to organic production systems. Concern about the production and handling requirements that organic standards would impose and the overarching environmental impacts that organic systems attempt to address has pointed research and development efforts in some new directions. Current research activities with important implications for the organic aquaculture industry include: alternative feeds, especially protein sources from grain and oilseed plants; culture of low-trophic aquatic species; disease management and use of natural and alternative medicines; polyculture and multi-species systems; self-filtering systems; techniques for expanded recovery of fishery by-catch and waste for use in organic systems; implications of using closed containment systems; environmentally sound effluent management systems; and consumer studies related to food preferences and purchasing habits.

The most recent World Aquaculture Society meeting, held in Honolulu, Hawaii, March 1-5, 2004, included several presentations by leading researchers in the aquaculture field dealing with organic-related activities. Additionally, some key international research into organic aquaculture has resulted from on-farm experimentation by current producers of certified organic aquacultural products. The experiences of these producers serve as case studies for further exploration of research needs in organic aquaculture.

In the U.S., the U.S. Department of Agriculture (USDA) provides leadership and funding for aquaculture research, technology development, and extension programs. The Agricultural Research Service (ARS), the primary research agency within USDA, has identified aquaculture feeds, water use and reuse, effluent management, social sustainability, and environmental sustainability as problems to be addressed through the Sustainability and Environmental Compatibility of Aquaculture component of its action plan for the aquaculture national programs. Some of the research objectives of the organic aquacultural community may be addressed through this mechanism.

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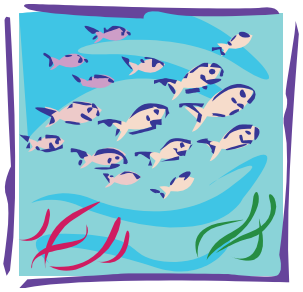

Conventional Aquaculture: Overview

The foundation for commercial aquaculture in the U.S. was laid more than 100 years ago. During the late 1860s, Spencer F. Baird, assistant secretary of the Smithsonian Institution, lobbied Congress to fund studies about a deteriorating fisheries situation, resulting in the creation of the U.S. Fish and Fisheries Commission in 1871. Baird, as the first Commissioner, instigated a research program in the marine sciences which helped to establish the basis of government-sponsored research and development in aquaculture and oceanography. In the next century, aquaculture progressed from the domain of hobbyists and hatcheries to an industry with large institutional support. For example, by 1960, several universities had developed aquaculture programs in cooperation with the U.S. Fish and Wildlife Service. As the outlook for fisheries continued to raise concerns, aquaculture acquired increasing status as an alternative source of foodfish. It became not only a profitable industry, but it also assumed an important role in addressing food security issues in developing countries.

The 1970s and 1980s, saw an increase in the support and scope of aquacultural activities. The U.S. Agency for International Development (USAID) established aquaculture projects in developing nations. The National Aquaculture Act, passed by Congress in 1980, mandated the establishment of a National Aquaculture Development Plan, published in 1983. Regional aquacultural centers were created through the efforts of the U.S. Department of Agriculture (USDA) in the mid-1980s to support industry research needs. Additionally, the World Mariculture Society, later the World Aquacultural Society (WAS), became the leading organization of aquaculture professionals during this period. [Stickney, 1996]

This investment in aquaculture has returned results. According to the USDA, Economic Research Service (ERS), "Between 1980 and 1998, the value of U.S. aquaculture production rose over 400 percent. The 1998 Census of Aquaculture reported farm-level sales of $972 million." The ERS also reported that "the catfish industry is the largest sector in U.S. aquaculture, accounting for almost half of all sales. Other major foodfish species grown in the United States are trout, salmon, tilapia, hybrid striped bass, sturgeon, walleye, and yellow perch." Additional farmed species include oysters, clams, baitfish, ornamental fish, alligator, turtles and algae. Most of the farmed aquatic species in the U.S. are raised in upland freshwater systems and a mixture of operations comprises the balance of production. [*Briefing Room: Aquaculture*, 2004]

The October 2003 ERS publication *Aquacultural Outlook* explained, "U.S. producers are at a disadvantage in the production of warm water species that require large expanses of coastal property, they do have some advantages for cool or cold water species, especially those that can be grown in fresh water on a mostly grain-based diet." [Harvey, 2003, p. 1]

In terms of trade the ERS reports, "While the United States is a major seafood exporter, its exports of aquaculture products are relatively small: some farm-raised trout and salmon chiefly to Canada and Mexico and oysters and clams to Canada. The catfish industry has been attempting to develop export markets in Europe but has met with only limited success. The ornamental fish industry exports its products to a number of countries, but the United States is a net importer of ornamental fish. On the other hand, the United States is a major importer of farm-raised seafood products. The largest categories of imported aquaculture products are shrimp, salmon, and tilapia." [*Briefing Room: Aquaculture*, 2004]

The outlook for aquaculture worldwide is also growing. "According to FAO statistics, aquaculture's contribution to global supplies of fish, crustaceans and molluscs continues to grow, increasing from 3.9 percent of total production by weight in 1970 to 27.3 percent in 2000. Aquaculture is growing more rapidly than all other animal food producing sectors. Worldwide, the sector has increased at an average compounded rate of 9.2 percent per year since 1970, compared with only 1.4 percent for capture fisheries and 2.8 percent for terrestrial farmed meat production systems." [FAO, 2002, p. 26]

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Conventional Aquaculture: Production Systems

Aquaculture is defined as the production of aquatic animals and plants under controlled conditions for all or part of their lifecycle. [*Briefing Room: Aquaculture*, 2004] The combination of the environment, equipment, and techniques selected for the farming of an aquatic species is referred to as the aquaculture production or cultural system. Several different types of systems have been developed based on availability of environmental resources and the type of species being raised. Environmental factors that can influence aquacultural system and species selection include salinity of the water (marine, brackish and fresh), seasonal climate, watershed drainage, and tides. Particular systems are most commonly found in the U.S. region where the climate is appropriate to a certain species: trout and salmon in the Northwest, catfish and other warmwater species in the Southeast, and marine species in Hawaii, California and the Gulf States. The major aquaculture systems are cage culture, pond, raceway, recirculating and integrated. Each of these systems has characteristics that may lead to consideration for organic production. A short description and selected resources for each type of system are presented below.

Cage culture

Cage culture utilizes hanging or floating containers that are anchored to remain in location. The open nature of the structures allows for natural water movement, such as tides and currents, to provide water circulation for oxygenation, delivery of nutrients and removal of wastes. Bottom culture and other systems for mollusk species or net-pens are some methods that also use open water flow as a main component of the production system.

Ponds

Ponds are constructed outdoors using earthen dams or by taking advantage of topographical depressions. They are generally clustered in groups covering several acres. The water source used to fill the ponds can be runoff or pumped from wells. Drainage and aeration equipment is employed to control the water level and quality of the system.

Raceways

Also known as flow-through systems, raceways are generally comprised of rectangular or circular tanks with a high volume, constant source of flowing water. Water sources such as wells, springs or streams that provide consistent water temperature, flow rate and quality are preferred. These systems are designed to flush accumulated waste products through or out of the system for collection.

Integrated Systems

Several methods of integrated aquaculture, such as polyculture or aquaponics, are currently in use. Polyculture is the simultaneous culture of two or more plant or animal species. Aquaponics incorporates recirculating aquaculture and hydroponic growing techniques to utilize waste water from fish culture for production of a vegetative crop. The plants grown may improve water quality through biological filtration of excess nutrients and addition of dissolved oxygen. The particulars of an aquacultural operation may generally determine which type of integrated system will be implemented. This type of system is attractive to some producers since it allows for the production of two crops using one infrastructure. However, some producers may use one or more of the species to provide benefit to another species solely for the favorable result and not as a harvestable product.

Recirculating Systems

Recirculating systems, predominantly employed with closed tanks, use intensive filtration and water treatment systems to maintain the quality of the water, which is reused many times before being replaced. Due to the small volume of water needed to operate this system, it can be used in many settings and in most climates. The waste from these systems is generally high in nutrients and may be used for land application in some operations.

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Conventional Aquaculture: Environmental Issues

Aquacultural activities, like their terrestrial farming counterparts, affect surrounding ecosystems. Despite numerous regulations aimed at ameliorating these effects, environmental impacts currently associated with some operations and practices draw criticism of the industry. Concerns include pollution from solid waste and effluent by-products, pesticide and antibiotic residues, introductions of species to non-native environments, and transmission of disease between individual organisms and to other species. These impacts have been documented across several production systems and types of farmed species.

Developments in research and policy are increasingly being focused on resolving these environmental problems. Members of the aquaculture community believe that sustainable and ecologically based management practices can lead to environmentally benign aquacultural operations. One aquaculture researcher envisions a future where "ecological agriculture research is oriented to the design, development, and monitoring of aquatic farming systems that preserve and enhance the form and functions of the natural and social environments in which they are suited. Aquaculture depends upon inputs from various food, processing, transportation and other industries, and can produce valuable, uncontaminated wastewaters and fish processing wastes, all of which can be a vital part of an ecological system that can be planned and organized for community-based aquatic foods production – and natural ecosystem rehabilitation, reclamation and enhancement – not degradation." [Costa-Pierce, 2002, p. 343] Additionally, aquaculture may provide some relief to over-fishing pressures for some species by supplying rising consumer demand for these products. Thus, the opportunity exists to create aquacultural systems that are models of environmental stewardship. The development and implementation of organic production practices may lead the way in this effort.

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Conventional Aquaculture: Laws and Regulations

In the United States, responsibility for regulating aquacultural activities is shared between several Federal, State and some local agencies. Federal agencies regulate activities that fall within the scope of their mandated duties. For instance, the U.S. Environmental Protection Agency (EPA) is responsible for waste water permitting across all industries and the U.S. Food and Drug Administration (FDA) covers food safety regulations and drug approvals. Additionally, legal definitions of aquaculture and aquacultural practices, ownership of animals or plants that may also be considered wildlife, water rights for fresh and marine bodies, and other such legal "principles" are established by Federal decision-makers. Several Federal agencies should be consulted when determining which regulations are applicable to aquaculture.

State and local governments generally regulate activities that are permitted or licensed at the community level. Main classes of permits deal with building, water use, waste discharge, species certification related to wildlife management, marketing or processing, and trade. Often, regulations are in effect based on the siting of the operation: inland, wetland, coastal and off-shore. Due mainly to environmental concerns, requirements for each type of operation are varied. Each State administers aquacultural permitting based on its own rules. Thus, regulations can vary considerably among geographic locations.

Internationally, aquaculture laws and regulations can be as varied and decentralized as the U.S. laws. In his book, *The Law of Aquaculture*, Howarth lists many court cases, statues and regulations in Britain that guide aquacultural activities such as licensing, disease control, water management, predator control, harvesting, and marketing guidelines. Many more examples of this distributed approach to aquacultural laws are presented in a United Nations (UN) review of aquaculture legislation globally. In addition to many examples throughout the text of national-level legislation that covers requirements such as licensing, land and water rights, environmental protection and fish disease and transportation; the authors of the UN report identify categories for government of aquaculture worldwide. These categories are: countries that have established a specific set of rules for aquaculture, countries with some aquacultural legislation to cover various species, systems or disputed circumstances, and countries with basic laws or clauses of other laws (generally Fisheries laws) that permit aquaculture. A great deal of variation within and between government regulations exists worldwide.

The UN has also played a significant role in the development of international law for seas and fisheries that has direct impact on coastal or open ocean aquacultural operations. The 1982 United Nations Conference on the Law of the Sea (UNCLOS) set offshore territorial boundaries that establish zones of exclusive economic and fisheries rights for coastal nations. While some nations have not ratified this convention, it is the *de facto* set of guidelines, until changed, for the world's oceans. Furthermore, the UN has developed a *Code of Conduct for Responsible Fisheries*, based on international laws including UNCLOS. In the introduction to this document, an explanation of the scope of and impetus for these rules is presented:

"Fisheries, including aquaculture, provide a vital source of food, employment, recreation, trade and economic well being for people throughout the world, both for present and future generations and should therefore be conducted in a responsible manner. This Code sets out principles and international standards of behaviour for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity." Thus, aquacultural operations may be obliged to meet principles of conduct in addition to routine legal regulations.

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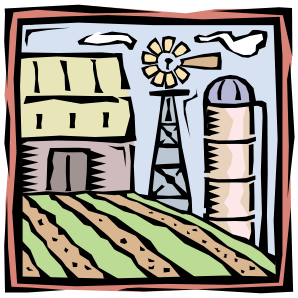

Organic Agriculture: Overview

Commercial organic agriculture has been practiced in the United States for more than fifty years. Today, it is a small but rapidly growing sector of the agricultural economy. Certified organic cropland for corn, soybeans, and other major crops more than doubled from 1992 to 1997, and doubled again between 1997 and 2001. Two organic livestock sectors - poultry and dairy – grew even faster. [*Data: Organic Production*, 2004]

"Organic food production promotes biodiversity, biological cycles and biological activity. Organic farmers aim to manage food production as an integrated, whole system that is, as Fred Kirschenmann, former National Organic Standards Board Livestock Chair describes, an 'organism' whose individual parts mesh together into one whole production system. For example, in livestock production, the organic farmer relies on biological processes to integrate the management of individual parts including nutrient inputs, the animals themselves, the environment in which they live and the waste that is produced. These individual parts are connected, each component depending on every other component. When these parts are balanced within the production system, the system can be considered sustainable – one of the goals of organic production." [Brister and Kapuscinski, 2000, p. 1]

From a marketing perspective, growth in retail sales has equaled 20 percent or more annually since 1990. Organic products are now available in nearly 20,000 natural foods stores, and are sold in 73 percent of all conventional grocery stores. Fresh produce is the top-selling organic category in retail sales. Nine U.S. Department of Agriculture (USDA) agencies have expanded research, regulatory, and other programs on organic agriculture. Programs include crop insurance for organic farmers, information and outreach providers, and promotion of organic exports. The USDA National Organic Program (NOP) oversees the creation, implementation, and administration of the USDA organic standard. [Dimitri and Greene, 2002, p. iii]

"U.S. producers are turning to organic farming systems as a potential way to lower input costs, decrease reliance on nonrenewable resources, capture high-value markets and premium prices, and boost farm income. Organic farming systems rely on ecologically based practices, such as cultural and biological pest management, and virtually exclude the use of synthetic chemicals in crop production and prohibit the use of antibiotics and hormones in livestock production. Many producers, manufacturers, distributors, and retailers specialize in growing, processing, and marketing an ever widening array of organic food and fiber products." [*Briefing Room: Organic Farming and Marketing*, 2004]

Internationally, organic agriculture has achieved progress similar to that in the U.S. A 2003 survey, undertaken in collaboration with the International Federation of Organic Agriculture Movements (IFOAM), summarized its main findings:

- "Organic agriculture is practiced in almost all countries of the world, and its share of agricultural land and farms is growing. The total organically managed area is more than 24 million hectares world-wide. In addition, the area of certified "wild harvested plants" is at least a further 10.7 million hectares, according to various certification bodies;
- "The market for organic products is growing, not only in Europe and North American (which are the major markets) but also in many other countries. It is valued at 23 billion USD (2002)
- "Official interest in organic agriculture is emerging in many countries, shown by the fact that many countries have fully implemented regulation on organic farming or are in the process of drafting regulation." [Willer and Yussefi, 2004, p. 7]

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Organic Agriculture: *Standards and Certification*

Prescribed production and product handling standards accompanied by state and/or private certification systems are an important aspect of organic farming, marketing, and trade. Certification processes provide consumers with assurance that they are buying a consistent product and farmers and handlers with a "level playing field," in terms of management and marketing. "At least 100 regional or national standards have been developed worldwide. Several countries are formulating or have adopted laws and regulations on organic production and processing and on certification requirements to control the use of labels indicating organic origin." [Jacobsen, 2002, p. 4]

October 2002 saw the full implementation of the U.S. Department of Agriculture (USDA) National Organic Standards (CFR 7 Part 205). Since that date, all agricultural products that are labeled and marketed in the U.S. as "organic" must meet USDA standards and be certified by a USDA-accredited certifying agent. The Organic Foods Production Act of 1990 (OFPA) mandated uniform standards for the organic industry. "Congress passed the Act to: (1) establish national standards governing the marketing of certain agricultural products as organically produced products; (2) assure consumers that organically produced products meet a consistent standard; and (3) facilitate commerce in fresh and processed food that is organically produced." [*Background and History*]

The completed standards/Final Rule appeared in the December 21, 2000 *Federal Register* and was activated on April 21, 2001. "This final rule establishes the National Organic Program (NOP or program) under the direction of the Agricultural Marketing Service (AMS), an arm of the United States Department of Agriculture (USDA). This national program will facilitate domestic and international marketing of fresh and processed food that is organically produced and assure consumers that such products meet consistent, uniform standards.

"This program establishes national standards for the production and handling of organically produced products, including a National List of substances approved for and prohibited from use in organic production and handling. This final rule establishes a national-level accreditation program to be administered by AMS for State officials and private persons who want to be accredited as certifying agents. Under the program, certifying agents will certify production and handling operations in compliance with the requirements of this regulation and initiate compliance actions to enforce program requirements.

"The final rule includes requirements for labeling products as organic and containing organic ingredients. This final rule also provides for importation of organic agricultural products from foreign programs determined to have equivalent organic program requirements. This program is authorized under the Organic Foods Production Act of 1990, as amended." [*Federal Register*, p. 80548]

To help clarify the over arching principles that describe "organic agriculture," the National Organic Standards Board (NOSB) presented a definition in 1995: "Organic agriculture is an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony. 'Organic' is a labeling term that denotes products produced under the authority of the Organic Foods Production Act.

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Organic Agriculture: Standards and Certification (continued)

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"The principal guidelines for organic production are to use materials and practices that enhance the ecological balance of natural systems and that integrate the parts of the farming system into an ecological whole. Organic agriculture practices cannot ensure that products are completely free of residues; however, methods are used to minimize pollution from air, soil and water. Organic food handlers, processors and retailers adhere to standards that maintain the integrity of organic agricultural products. The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals and people." [*Final Minutes*, 1995]

There are currently 94 USDA-accredited certifying agents, 34 of which are located outside the United States. These agents are indicative of a strong domestic and international presence overseeing organic certification and standards worldwide. While there is not one internationally recognized organic standard, the International Federation of Organic Agriculture Movements (IFOAM), founded in 1972, has developed Basic Standards and an International Organic Accreditation Service (IOAS) through which certifying agents may become "IFOAM accredited."

IFOAM has also worked in collaboration with other entities including the Food and Agriculture Organization/ World Health Organization Food Standards Programme Codex Alimentarius and with the European Union which enacted a regulation governing organic production and foods in 1991. Most European countries also rely on their own organic legislation. Other countries with organic regulations include Argentina, Australia, Bulgaria, Canada, China, Costa Rica, Czech Republic, Hong Kong, India, Ireland, Japan, and New Zealand. [*Organic-research.com*, 2004]

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