

Week 2. Inland aquaculture, Coastal aquaculture and mariculture

Inland aquaculture produces most farmed aquatic animals, mainly in freshwater; hence, it is interchangeably called freshwater aquaculture in most producing countries. In some countries, inland aquaculture also uses saline–alkaline waters to grow local species naturally adapted to such environments, or introduced species, including marine species, that tolerate the conditions and perform satisfactorily in meeting farmers’ expectations. Farming systems are very diverse in terms of culture methods, practices, facilities and integration with other agricultural activities. Earthen ponds remain the most commonly used type of facility for inland aquaculture production, although raceway tanks, aboveground tanks, pens and cages are also widely used where local conditions allow. Rice–fish culture remains important in areas where it is traditional, but it is also expanding rapidly, especially in Asia. However, there have been rapid and significant advances in the improvement of integrated inland aquaculture farming systems in recent years, resulting in not only higher productivity and improved resource-use efficiency, but also reduced impact on the environment. In 2018, inland aquaculture produced 51.3 million tonnes of aquatic animals, accounting for 62.5 percent of the world’s farmed food fish production, as compared with 57.9 percent in 2000. In inland aquaculture, the dominant position of finfish was gradually reduced from 97.2 percent in 2000 to 91.5 percent (47 million tonnes) in 2018, reflecting the strong growth of other species groups, particularly crustacean farming in freshwater in Asia, including shrimps, crayfish and crabs. Inland aquaculture production of shrimps includes significant volumes of marine species such as the whiteleg shrimp grown in freshwater and in some arid regions with saline–alkaline water, for example, the Gobi Desert in Xinjiang, China, the farthest place from the sea on earth.

Coastal aquaculture and mariculture

Coastal aquaculture plays an important role in livelihoods, employment and local economic development among coastal communities in many developing countries. It is practised in completely or partially artificial structures in areas adjacent to the sea, such as coastal ponds

and gated lagoons. In coastal aquaculture with saline water, the salinity is less stable than in mariculture because of rainfall or evaporation, depending on the season and location. Although coastal ponds for aquaculture, modern or traditional, are found in almost all regions in the world, they are far more concentrated in South, Southeast and East Asia and Latin America for raising crustaceans, finfish, molluscs and, to a lesser extent, seaweeds. While many Asian countries, and more recently, Latin American, European and North American countries have developed their expertise and support institutions for marine and coastal aquaculture, most African countries are far behind despite ambitious projections at the regional and national levels. Proper policies and planning, supported by an enabling environment in support of infrastructure, technical expertise and investment are needed to promote marine aquaculture in Africa. Mariculture, or marine aquaculture, is conducted in the sea, in a marine water environment. For some species whose production relies on the naturally occurring seed in the sea, the production cycle is entirely in the sea. For those species that rely on seed produced from hatchery and nursery facilities even in freshwater, mariculture represents the grow-out phase of the production cycle. Because countries usually combine production from coastal aquaculture and mariculture for data reporting to FAO, it is difficult to separate mariculture from coastal aquaculture figures. This is particularly the case for finfish produced from both coastal ponds and cages in the sea, especially in Asia.

Aquatic species produced

The great diversity of climatic and environment conditions in locations across the world where aquaculture is practised has given rise to a rich and diverse number of species utilized in different types of aquaculture production practices with freshwater, brackish-water, marine water and inland saline water. For 2018, FAO has recorded aquaculture productions for reporting countries and territories under a total of 622 units, defined for statistics purpose as “species items”. Aquaculture production of these 622 species items corresponds to 466 individual species, 7 interspecific hybrids of finfish, 92 species groups at genus level, 32 species groups at family level, and 25 species groups at the level of order or higher. However, counting the number of “species items” can be misused by many as the total number of farmed aquatic species. For example, in the FAO database, in addition to European seabass (*Dicentrarchus labrax*) and spotted seabass (*D. punctatus*), there is also the

production data of “seabass not elsewhere included” (*Dicentrarchus spp.*) for when the reporting country was not sure of the exact species produced. This results in three species items, whereas in reality the genus *Dicentrarchus* has only two species. The above-mentioned numbers do not include those species produced from aquaculture research experiments, cultivated as live feed in aquaculture hatchery operations, or ornamental aquatic animals produced in captivity. The total number of commercially farmed species items recorded by FAO has increased by 31.8 percent, from 472 in 2006 to 622 in 2018, as a result of further FAO’s investigations and improvement in data reporting by producing countries. However, the FAO data do not keep pace with the actual species diversification in aquaculture. Numerous single species registered in the official statistics of many countries consist in reality of multiple species, and sometimes hybrids. While FAO has recorded only seven finfish hybrids in commercial production, the number of hybrids farmed is much greater. As of 2018, there were about 200–300 more species, including some hybrids, known to have been farmed in aquaculture in addition to the above-mentioned 466 species and 7 hybrids. Their absence from the FAO global production statistics is due to the difficulties encountered in field data collection, the highly aggregated species grouping in the standard list of species in national statistics system, and data confidentiality in respect of national laws. Despite the great diversity in the species raised, aquaculture production by volume is dominated by a small number of “staple” species or species groups at the national, regional and global levels. Finfish farming, the most diverse subsector, contains 27 species and species groups, which accounted for over 90 percent of total finfish production in 2018, of which the 20 most important species accounted for 83.6 percent of total finfish production (Table 8). Compared with finfish, fewer species of crustaceans, molluscs and other aquatic animals are farmed. Aquatic algae In 2018, farmed seaweeds represented 97.1 percent by volume of the total of 32.4 million tonnes of wild-collected and cultivated aquatic algae combined. Seaweed farming is practised in a relatively smaller numbers of countries, dominated by countries in East and Southeast Asia. The world production of marine macroalgae, or seaweed, has more than tripled, up from 10.6 million tonnes in 2000 to 32.4 million tonnes in 2018. Despite the slowdown in growth rates in recent years, the rapid growth in the farming of tropical seaweed species (*Kappaphycus alvarezii* and *Eucheuma spp.*)

Salmon and trout Salmon

Salmon particularly farmed Atlantic salmon, has proved a versatile and popular seafood item that aligns with trends in modern consumer preferences. Driven by strong demand in both developed and developing markets in almost every world region, salmon has become the largest single fish commodity by value. The markets for farmed coho salmon, rainbow trout and wild salmon species from North Pacific fisheries have all experienced growth, but it is Atlantic salmon that accounts for the largest proportion of export revenue. Atlantic salmon aquaculture, led by Norway and Chile, is one of the most profitable and technologically advanced fish production industries globally, while on the market side the industry is notable for coordinated international marketing strategies and a rapid pace of product innovation. Physical and regulatory restraints on production growth helped to push traded salmon prices to record highs in 2018, levels that were approached once again in late 2019 and early 2020. Shrimp Shrimp and prawns have historically been one of the most heavily traded fish products, with the bulk of production taking place in Asia and Latin America and the major markets located in the United States of America, the European Union and Japan. In more recent times, however, shrimp's share of total trade has been declining and it has been overtaken by salmon in terms of total traded value. Emerging markets, particularly China, are increasingly important targets for exporters and marketers of shrimp, whereas the scope for further growth in the traditional developed markets is limited. The farmed shrimp sector, which now supplies the majority of volume to the global market, has also suffered from the impact of disease outbreaks and price variations associated with the boom-and-bust cycle. High volumes of aquaculture production in 2018 and 2019 pushed market prices to low levels, leading to conservative planning by producers. An increase in Chinese imports, to a large extent attributable to a crackdown on illegal (and unreported) smuggling of shrimp via intermediary countries such as Viet Nam, has supported increases in export revenue for Ecuador in particular.

Tuna

Most canned tuna is destined for the markets of the United States of America and the European Union, while Japan is the world's largest importer of fresh and frozen tuna in whole

or loin form. Major imported-tuna processing and re-export industries are located in China, Ecuador, the Philippines, Spain and Thailand. Raw material is sourced from long-distance tuna fleets fishing regional tuna stocks managed by regional fisheries management organizations (RFMOs). It comprises multiple species in the tropical and subtropical latitudes of the Atlantic, Pacific and Indian Oceans. Bluefin and bigeye tuna are typically used for sashimi and sushi, while skipjack, albacore and yellowfin are used in canned and other prepared and preserved products. Canned tuna is marketed and sold largely through consolidated supermarket chains as an affordable food fish item, while sashimi and sushi are targeted at health-conscious consumers amid a general increase in the popularity of Japanese cuisine in international markets. In late 2019, a surplus of tuna catches saw traded prices for tuna raw material drop to record lows (Figure 36), which in turn resulted in a drop in export revenues for major processors, although prices recovered in early 2020.

Sea Bass and Sea Bream

Intensive production of European seabass (*Dicentrarchus labrax*) and Gilthead seabream (*Sparus aurata*) in the Mediterranean is a relatively young industry that began in the late 80s, grew exponentially in the 90s and has continued its expansion during the following two decades. Although the sector has faced several crises, the production increased every year during the 2011–2017 period, from 268,952 tonnes in 2011 to 426,744 tonnes in 2017 (FAO, [2018](#)). About 90% of the seabass and seabream production is concentrated in 6 countries: Turkey (37%), Greece (25%), Egypt (14%), Spain (9%), Tunisia (4%) and Italy (4%).