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# FISH FARMING PROJECTS AROUND THE WORLD: A PRESENTATION OF SELECTED STATISTICS FROM THE FOOD AND AGRICULTURE ORGANISATION (FAO), 2022 REPORT

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**ABSTRACT**

This paper aims to shed light on one of the most significant food-related projects: fish farming. Its importance is evident both at the individual level, by providing high nutritional value, and at the national level, through its contribution to economic and social development (food security, self-sufficiency, etc.). It also offers profitability for institutions operating within a market that is flourishing daily. The Food and Agriculture Organisation (FAO) has emphasised the importance of investing in this sector. Accordingly, this paper presents key statistics from the FAO's 2022 report. The findings indicate that fish farming production reached an estimated 120 million tonnes in 2020, a remarkable increase considering that the activity was once marginal and only began to develop from 1985 onwards. China leads in global production, accounting for more than 50%. Regionally, Asia ranks first in terms of global output, followed by Africa and Europe. Egypt is Africa's largest fish farming producer, contributing approximately 3% of global production. It is hoped that Algeria will increase its investment in this sector to achieve food security, particularly given its vast potential and capacity to take a leading position.

**KEYWORDS**

Aquaculture, Asia, China, Fish Farming, Inland Waters, Sustainability

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## Introduction.

Global fish farming production has experienced remarkable growth since the mid-1980s. This expansion has significantly increased its importance as a mode of food consumption and a contributor to global food security. With the advancement of aquaculture technologies and the diversification of production systems, it has become essential to understand the characteristics of these systems to evaluate their performance and manage them economically.

Fish, whether sourced from natural habitats or aquaculture, represent a primary source of protein and essential nutrients. In Bangladesh, Indonesia, Sri Lanka, Gambia, Sierra Leone, and Ghana, fish protein contributes approximately 60% of individuals' total dietary protein intake (Bayoumi, 2016). Among Arab countries, Egypt ranks first in terms of fish production, accounting for approximately 92.5% of aquaculture output in the Arab world, whereas production from natural fisheries represents only approximately 15%. Pond aquaculture holds the most significant share in this sector, alongside floating cages and fish farming integrated with rice fields (El-Morsi, 2012).

Algeria is among the countries that have entered the field of aquaculture, albeit in a modest manner, to achieve self-sufficiency in this food source. However, its production remains low compared with the available potential, whether along its coastal strip, in inland ponds constructed on land, or within rivers and water reservoirs. Therefore, this paper aims to present key statistics from the Food and Agriculture Organisation (FAO) report, including production levels, the world's top producers, geographical distribution, and the leading regions in fish and aquaculture production.

**Definition.**

Fish farming is defined as “activities undertaken by investors to develop and manage fish resources in specific areas or enclosed spaces, placing them in earthen or concrete ponds or metal cages in such a way that allows for control over the species and quantities of targeted fish, the method and timing of their harvest, and their marketing, all with the aim of achieving economic and social objectives” (Al-Jamma’, 2021, p. 16).

According to the FAO, aquaculture is “the farming of aquatic organisms (fish, molluscs, crustaceans, aquatic plants, etc.), under two main conditions: human intervention in the rearing process to increase production and individual or legal ownership of the farmed organisms” (Abi Ayad, n.d., p. 10).

There are three key terms in the field of aquatic farming. First, aquaculture encompasses all animal and plant cultivation in freshwater, brackish, or saltwater environments. Second, pisciculture refers specifically to fish farming, a branch of aquaculture that focuses on cultivating fish. This farming is conducted in completely or partially enclosed areas (ponds, concrete or plastic tanks, traps, or cages).

Third, the integration of fish farming with agriculture involves introducing aquaculture into an agricultural setting. This approach leads to the development of both activities, either in parallel or sequentially, allowing one to benefit from the other's advantages. In general, owing to its significant protein yield, integrated fish farming is recommended in rural areas, particularly at the level of small- and medium-sized farms (Ghahouaci, n.d., pp. 1–2).

**II. Characteristics of Fish Farming**

The characteristics of fish farming include the following (Al-Jamma’, 2021, p. 16):

1. There is no competition between fish farming and other agricultural sectors over usable land, as fish farming projects can be established on land that is completely unsuitable for cultivation. Moreover, these projects require less operational energy than field-based projects do and offer high economic value within a relatively short period.
2. Fish farming contributes to rehabilitating uncultivable soil by increasing the salinity of lands adjacent to freshwater sources.
3. It serves as an ideal alternative to poultry and red meat products, helping to meet the demand for animal protein.
4. Fish farming helps address trade balance deficits and contributes to achieving self-sufficiency in fish production.
5. It offers a solution to problems arising from the closure of certain seasonal fisheries and supports natural fisheries by supplementing them with rare species.
6. This has created new investment opportunities in the fish feed industry and other industries linked to aquaculture.
7. It generates additional employment opportunities for those willing and able to work in the sector.

**III. Economic Importance of Fish Farming**

The social and economic significance of fish farming is reflected in the efficient use of resources, the achievement of food security, and the development of marketing systems (Jaber & Suleiman, 2009, pp. 7–9):

1. Control over marketing seasons by offering fish on the basis of consumer preferences and market demand for different species, which facilitates better management of storage-related challenges.
2. Optimal use of underutilised and unexploited resources, such as barren land unsuitable for cultivation, ponds, swamps, and wastewater.

3. Compared with other forms of animal production, there is less competition with humans for food resources. For example, poultry feed may contain up to 60% grain, whereas fish feed contains significantly less.
4. Aquaculture systems have higher feed-to-protein conversion rates than other animal production systems do, such as cattle, poultry, and sheep.
5. Compared with beef and poultry, fish meat has lower production costs and the lowest cost per unit of protein among all forms of animal protein production.
6. Fish farming represents the highest agricultural yield efficiency, surpassing livestock production by a factor of six.
7. The development of fish farming systems has contributed significantly and rapidly, with lower investment costs, to meeting the rising demand for meat and narrowing the existing supply gap. These investments in aquaculture are considered profitable and economically viable production projects.
8. Fish farming supports rural development. It provides household income and employment within rural sectors in low-income developing countries, thereby improving the quality of life in rural areas.
9. Given the availability of natural resources suitable for marine fish farms, aquaculture is a key pillar of development in coastal areas.
10. The high productivity per unit area or cubic meter of water in aquaculture systems, which far exceeds that of natural fisheries, helps reduce pressure on wild fish stocks. Moreover, some of the fry produced (either naturally or artificially) can be restocked into natural fisheries to preserve and support fish stock levels.
11. Fish farming constitutes a rapidly evolving technoeconomic system driven by combined efforts in biological and economic studies, including fry propagation, accelerated fish growth, feed mixing and manufacturing, disease resistance techniques, genetic enhancement, site selection, and the optimisation of production components.
12. Fish farming allows for the utilisation of low-value fish species, transforming them into high-value products such as fishmeal, fish oil, and fertilisers. Certain fish species capable of producing multiple small yields within a year can be raised with lower-quality water, such as treated wastewater. These fish can produce fertilisers or feed for fish, poultry, and livestock.
13. Fish farming projects are established within national boundaries, either in territorial waters or inland, shielding them from international disputes over exploitation rights and external influences.
14. Fish farming can contribute to environmental preservation by controlling aquatic weeds, water plants, and bilharzia snails in waterways through the cultivation of fish species that feed on these organisms.
15. The importance of fish farming also extends to supporting national development goals, such as reducing unemployment and addressing investment funding shortages, since these activities require relatively low capital investments.

**IV. Types and Systems of Fish Farming**

Fish farming systems are classified, on the basis of their purpose, into those designed to provide nutrient-rich animal protein for human consumption and those aimed at industrial or promotional use, including the cultivation of certain species as feed for predatory fish. On the basis of the fry source, some systems rely on collecting fry from natural sources and rearing them in enclosed environments; others involve collecting eggs from natural spawning and keeping them until hatching, followed by rearing them in intensive systems. There are also systems based on artificial insemination, where fry are produced in hatcheries and raised accordingly (El-Morsi, 2012, pp. 1–2).

From an economic perspective, fish farming systems are categorised by the level of input intensification into intensive, semi-intensive, and extensive systems. They are also classified according to water type into freshwater systems, saltwater systems (marine), or brackish water systems (Ibrahim, 2017, pp. 5–9).

**1. Intensive Fish Farming**

This system requires a high degree of control over feed quality, as it demands nutritionally rich diets, high-quality water, proper aeration, and continuous water renewal. It involves stocking many fish in small water areas and depends primarily on manufactured feed. Intensive fish farming yields high productivity, with outputs exceeding 20 tonnes per feddan.

**A. Advantages of intensive fish farming**

- High productivity with consistent fish size.
- This reduced land requirement makes it suitable for space-limited areas.

- Easy harvesting of fish due to controlled, confined systems.

**B. Disadvantages of intensive fish farming**

Some notable drawbacks of intensive systems include the following:

- High production costs are associated with increased labour requirements for managing and operating the farm.
- High stocking density increases the risk of disease outbreaks, particularly parasitic infections. In emergencies such as oxygen depletion, high fish mortality may occur.

**2. Extensive Fish Farming**

Extensive fish farming systems rely on the availability of large water bodies where fish are raised at low to moderate stocking densities. Productivity in this system typically reaches 2 tonnes per feddan per year.

**Advantages of intensive fish farming**

- Minimal changes in water properties maintain a more natural aquatic environment.
- Low labour requirements reduce operational costs.
- The lower disease incidence among fish is due to less intensive stocking.

**3. Hatchery Ponds**

Generally, hatchery ponds occupy approximately 1% of the total area of fish farms. These small ponds, ranging in size from 10 to 100 m², are used for spawning purposes. In natural spawning systems, males and females are placed together at a ratio of one male to three female tilapia. After spawning, the fry or larvae are left in the pond for approximately one week, after which they are collected and transferred to nursery ponds.

**4. Nursery Ponds**

Nursery ponds represent 5% of the total area of a fish farm. These ponds receive larvae from hatchery ponds and provide conditions that minimise loss rates as much as possible. The larvae are kept in these ponds until they reach the fingerling stage; at this point, they are transferred to grow-out ponds.

**5. Rearing Ponds**

Rearing ponds make up approximately 10% of the total area of the fish farm. These are designated for rearing fingerlings until they reach a specific size. Afterward, they are moved to fattening ponds. On many farms, rearing ponds are not established, and fingerlings are transferred directly from nursery ponds to fattening ponds, which may also serve as rearing ponds.

**6. Fattening ponds**

Fattening ponds occupy 70–80% of the total area of the fish farm. These ponds are used to grow farmed fish to market size.

**7. Holding ponds**

Depending on market preferences, these ponds store live fish that are ready for sale.

**V. Types of Fish Farming Systems by Species**

According to Ibrahim (2017, p. 7), fish farming systems may be categorised on the basis of species composition as follows:

1. Monoculture systems: In these systems, only one fish species is raised.
2. Polyculture systems involve the cultivation of multiple fish species simultaneously. This approach allows optimal vertical distribution within the water column and better utilisation of diverse feeding habits.
3. Integrated Aquaculture Systems: These systems combine fish farming with plant cultivation and livestock production, such as rice–fish farming or raising ducks and poultry alongside fish. Bird droppings are used as fertilisers to enrich pond water.

**VI. Freshwater Fish Species Commonly Used in Aquaculture**

According to Ibrahim (2017, p. 8), the most widely used species in freshwater aquaculture is tilapia, owing to several advantages:

- Rapid growth,
- Disease resistance,
- Adaptability to environmental conditions.

However, tilapia are known for early sexual maturity, leading to continuous pond reproduction. This results in overcrowding, which in turn results in slower growth rates due to intense competition for food, space, and dissolved oxygen. Consequently, the fish may reach market age with significant size variability, affecting overall product quality.

To resolve this issue, many farmers have adopted monosex (all-male) tilapia culture, as this method prevents uncontrolled reproduction and overcrowding. Furthermore, male tilapia present higher growth rates than females do.

**2. Methods for Producing Monosex Tilapia**

**a. Manual sex identification**

This method involves sorting tilapia on the basis of their reproductive organs. However, it has significant drawbacks, including high mortality rates due to handling stress and the requirement for extensive expertise and effort.

**b. Hybridisation Method**

This involves crossbreeding female Nile tilapia (*Oreochromis niloticus*) with male blue tilapia (*Oreochromis aureus*) to produce all-male offspring.

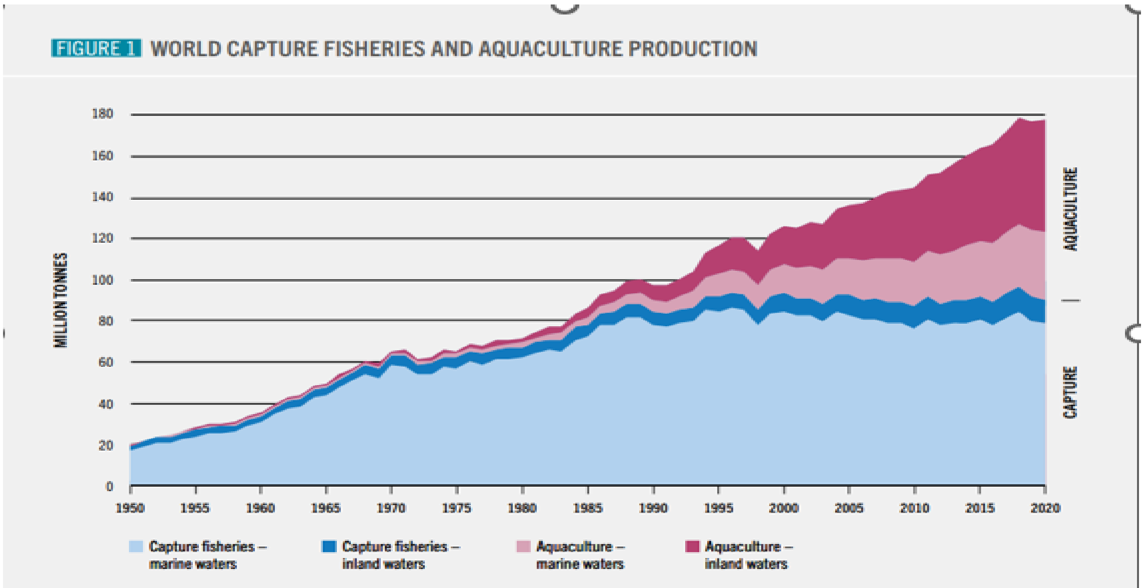
**c. Reversal of the hormonal sex**

This technique uses androgenic hormones to induce male characteristics. Although hormones breakdown during cooking due to high temperatures, the consumption of hormone-treated fish poses health risks, leading some agricultural ministries to ban the use of sex-reversal hormones in aquaculture for human safety.

Other fish species, such as carp, can also be farmed, with notable economic advantages. Moreover, catfish and African sharp-tooth catfish (*Clarias gariepinus*) are cultured to help control tilapia reproduction before they reach market size.

**VII. Fish Farming Statistics – FAO Report 2022**

According to the FAO (2022), the importance of fish farming as a key component of food security continues to grow. The following graph illustrates the development of production in this sector.



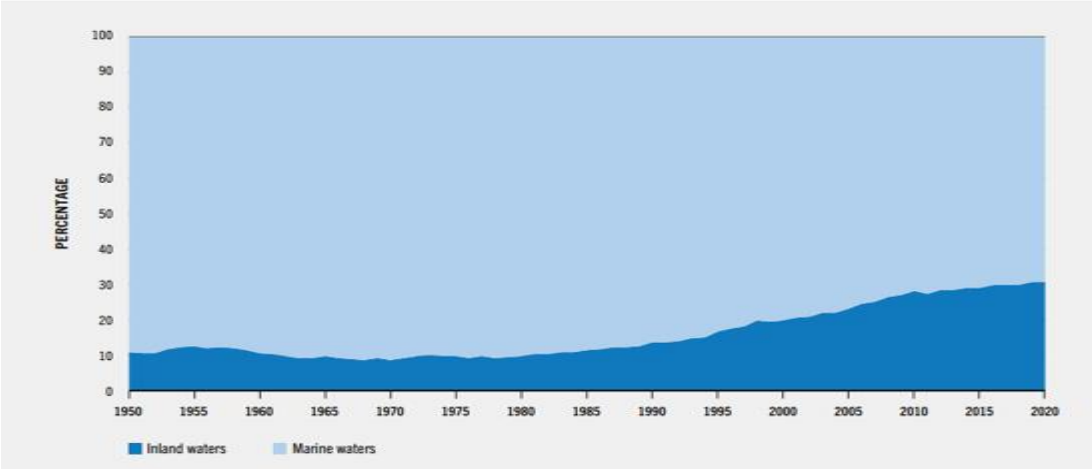

The figure shows that, during the 1950s, fish farming production was minimal or nearly nonexistent compared with natural fish production. During that period, natural production in marine waters surpassed that in inland waters. However, beginning in the 1980s, aquaculture expanded significantly in marine and inland water environments and has since followed a trajectory parallel to the growth of natural fish production.

Natural fisheries yielded approximately 80 million tonnes of fish in 2020, whereas aquaculture production surpassed this figure, reaching 120 million tonnes in the same year. This brought global fish production to approximately 180 million tonnes (FAO, 2022).

**2. Development of Marine and Inland Waters According to FAO Report 2022**

According to the FAO (2022), marine and inland aquaculture have continuously developed in recent decades, contributing increasingly to the global food supply and security.

FIGURE 4 SHARE OF WORLD TOTAL FISHERIES AND AQUACULTURE PRODUCTION BY INLAND AND MARINE WATERS

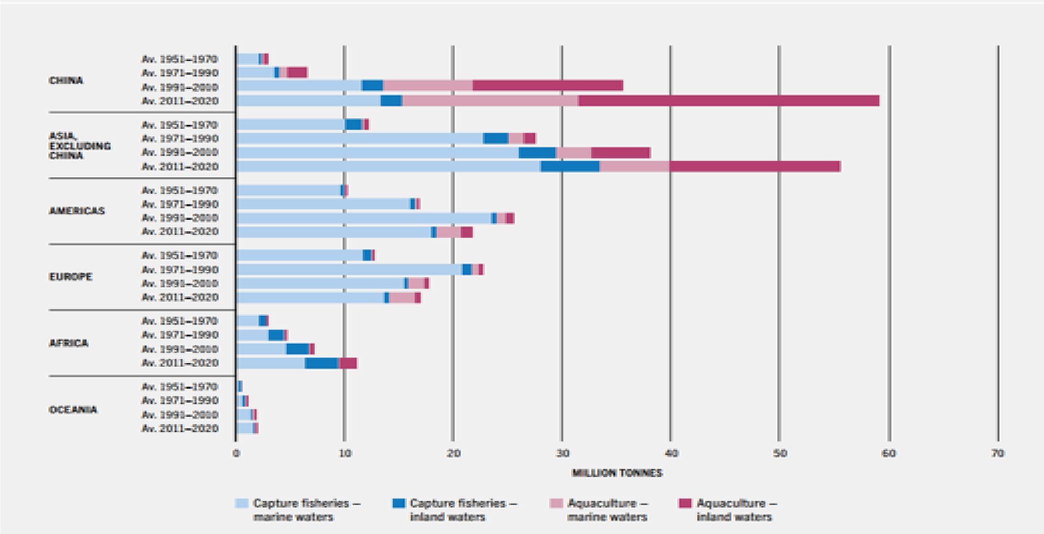



The figure illustrates the global percentage growth of fish capture in marine and inland waters. Marine waters represent the largest share of exploitation, accounting for approximately 90% of the total exploited area. However, starting in 1985, the exploitation of inland waters began to increase steadily, reaching 30% of the total exploited area by 2020 (FAO, 2022).

**3. Contribution of Each Region to Fish Production**

According to the FAO (2022) report, each global region's contribution to total fish production is assessed on the basis of data from aquaculture and capture fisheries.

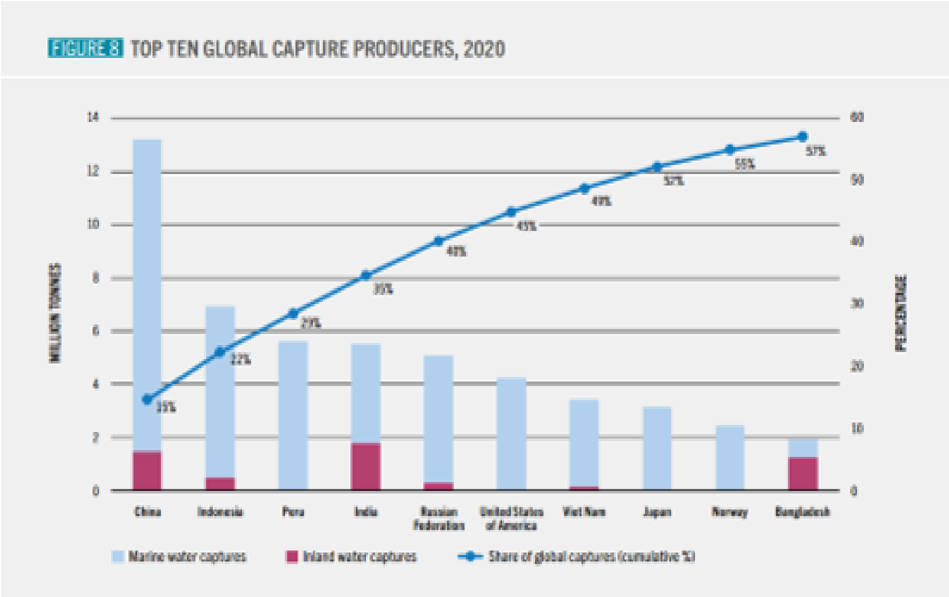
FIGURE 5 REGIONAL CONTRIBUTION TO WORLD CAPTURE FISHERIES AND AQUACULTURE PRODUCTION




The figure shows that China is the most significant regional contributor to global fish production, accounting for approximately 57% of the global output. Notably, growth in China's production became evident in 1991, which was driven mainly by its strong focus on aquaculture, particularly in inland waters. Like China, Asia contributes approximately 55% of global fish production; however, this figure excludes China, which alone surpasses the entire continent's output.

The American continent ranks next but is predominantly reliant on natural capture fisheries. In contrast, Africa's utilisation of fishery resources has not exceeded 12%, with aquaculture representing less than 1%, despite the continent's vast marine and inland water resources. Australia's engagement in fishery resource development does not appear to be very important (FAO, 2022).

### 4. Top Ten Fish-Producing Countries (FAO Report, 2022)

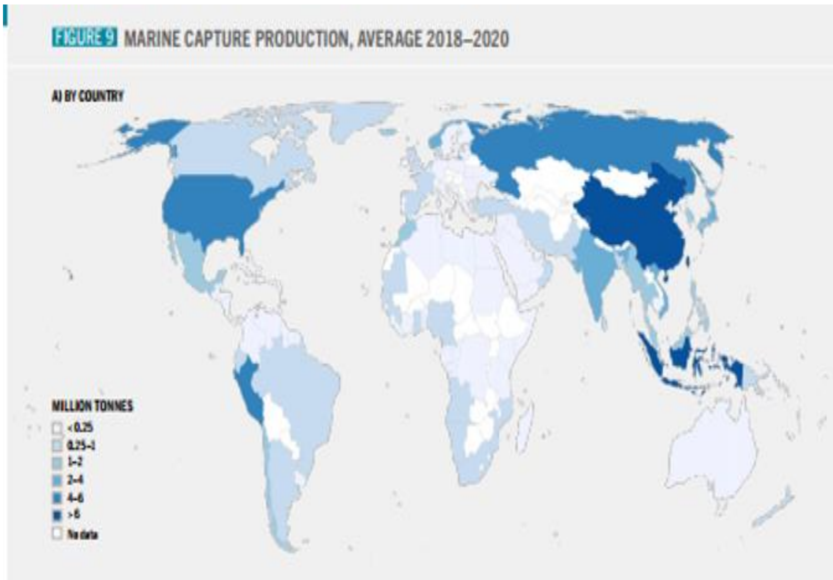



The figure reveals that China ranks first among the world's top ten fish-producing countries, with an estimated production of 13 million tonnes, representing approximately 55% of global production, of which 8% originates from aquaculture. Indonesia follows with nearly 7 million tonnes, whereas Peru ranks third with 5.5 million tonnes, which are sourced entirely from natural capture fisheries.

India is next with approximately 5.5 million tonnes, one-third of which comes from aquaculture. Russia follows this with 5 million tonnes, followed by the United States, which produces approximately 3.5 million tonnes. The United States, like Peru, Japan, and Norway, relies predominantly on natural fisheries.

Finally, Bangladesh stands out as a country where aquaculture dominates, accounting for two-thirds of its total fish production, representing approximately 10% of the global output (FAO, 2022).

### 5. Global Production Trends by Country (FAO Report, 2022), 2018–2020



The map indicates that, according to Food and Agriculture Organisation (FAO) statistics for 2018–2020, global fish production exceeded 6 million tonnes in Southeast Asia and ranged between 4–6 million tonnes in the United States and Russia. The production levels ranged between 2–4 million tonnes in India and Japan and between 1–2 million tonnes in Canada.

In contrast, production ranges between 0.25 and 1 million tonnes in South America, South Africa, and Mauritania, whereas production in Algeria, Tunisia, Libya, the Arabian Gulf, and Australia remains below 0.25 million tonnes (FAO, 2022).

## 6. Inland water aquaculture (FAO Report, 2022)

**TABLE 5 INLAND WATERS CAPTURE PRODUCTION: MAJOR PRODUCING COUNTRIES AND TERRITORIES**

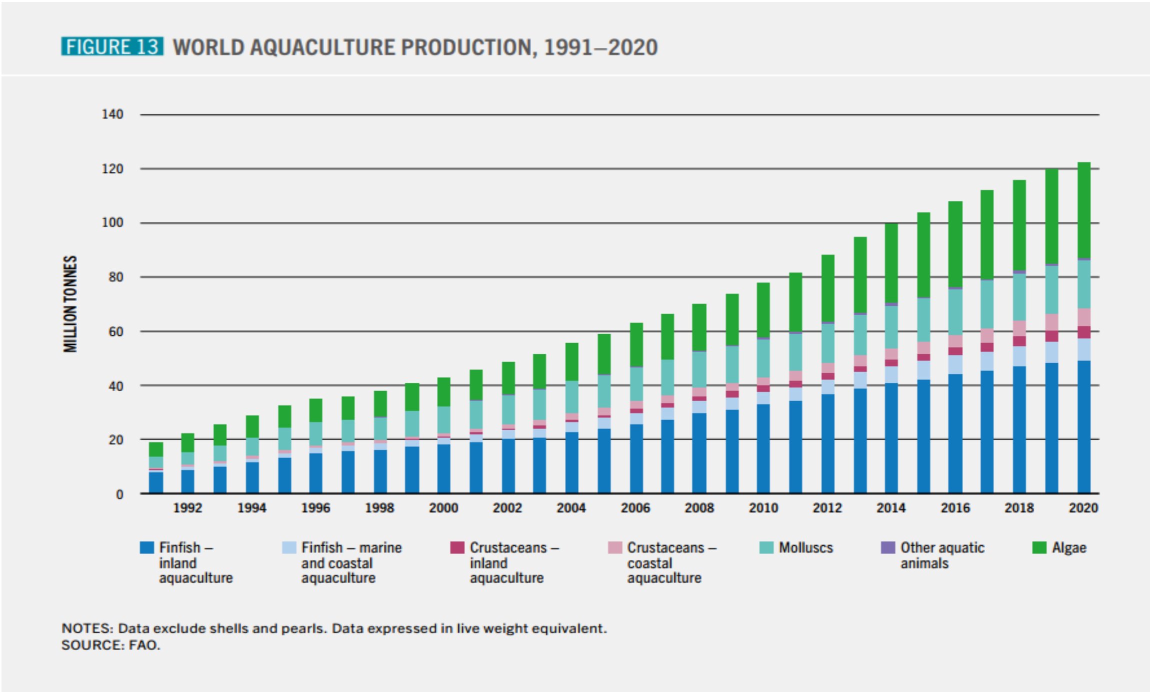
| Country | Production (average per year) | | | | Production | | | | Percentage of total, 2020 |
|---|---|---|---|---|---|---|---|---|---|
| | 1980s | 1990s | 2000s | 2010s | 2017 | 2018 | 2019 | 2020 | |
| | *(million tonnes, live weight)* | | | | | | | | |
| **Top 25 inland water capture producers** | | | | | | | | | |
| India | 0.50 | 0.58 | 0.84 | 1.43 | 1.59 | 1.70 | 1.79 | 1.80 | 16 |
| China | 0.54 | 1.46 | 2.11 | 2.03 | 2.18 | 1.96 | 1.84 | 1.46 | 13 |
| Bangladesh | 0.44 | 0.50 | 0.86 | 1.08 | 1.16 | 1.22 | 1.24 | 1.25 | 11 |
| Myanmar | 0.14 | 0.15 | 0.48 | 0.85 | 0.89 | 0.89 | 0.89 | 0.84 | 7 |
| Uganda | 0.19 | 0.22 | 0.33 | 0.44 | 0.39 | 0.44 | 0.60 | 0.57 | 5 |
| Indonesia | 0.27 | 0.31 | 0.31 | 0.47 | 0.47 | 0.66 | 0.71 | 0.49 | 4 |
| Cambodia | 0.05 | 0.09 | 0.34 | 0.46 | 0.47 | 0.42 | 0.40 | 0.41 | 4 |
| United Republic of Tanzania | 0.25 | 0.29 | 0.30 | 0.31 | 0.33 | 0.31 | 0.38 | 0.41 | 4 |
| Nigeria | 0.10 | 0.10 | 0.21 | 0.35 | 0.42 | 0.39 | 0.37 | 0.35 | 3 |
| Egypt | 0.12 | 0.23 | 0.27 | 0.25 | 0.26 | 0.27 | 0.30 | 0.32 | 3 |
| Russian Federation | 0.09 | 0.26 | 0.22 | 0.27 | 0.27 | 0.27 | 0.25 | 0.28 | 2 |
| Brazil | 0.20 | 0.18 | 0.24 | 0.23 | 0.22 | 0.22 | 0.22 | 0.22 | 2 |
| Democratic Republic of the Congo | 0.13 | 0.17 | 0.23 | 0.22 | 0.23 | 0.23 | 0.23 | 0.21 | 2 |
| Malawi | 0.07 | 0.06 | 0.06 | 0.14 | 0.20 | 0.22 | 0.15 | 0.17 | 1 |
| Mexico | 0.10 | 0.11 | 0.11 | 0.15 | 0.17 | 0.22 | 0.16 | 0.15 | 1 |
| Viet Nam | 0.11 | 0.14 | 0.21 | 0.16 | 0.16 | 0.16 | 0.15 | 0.15 | 1 |
| Pakistan | 0.07 | 0.13 | 0.12 | 0.13 | 0.14 | 0.14 | 0.14 | 0.15 | 1 |
| Philippines | 0.26 | 0.19 | 0.15 | 0.18 | 0.16 | 0.16 | 0.15 | 0.15 | 1 |
| Thailand | 0.10 | 0.18 | 0.21 | 0.19 | 0.19 | 0.14 | 0.13 | 0.13 | 1 |
| Mali | 0.07 | 0.09 | 0.10 | 0.10 | 0.11 | 0.09 | 0.11 | 0.12 | 1 |
| Chad | 0.05 | 0.08 | 0.08 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 1 |
| Zambia | 0.06 | 0.07 | 0.07 | 0.09 | 0.10 | 0.10 | 0.10 | 0.11 | 1 |
| Iran (Islamic Republic of) | 0.01 | 0.09 | 0.07 | 0.09 | 0.10 | 0.11 | 0.10 | 0.10 | 1 |
| Kenya | 0.09 | 0.18 | 0.14 | 0.13 | 0.10 | 0.10 | 0.10 | 0.10 | 1 |
| Mozambique | 0.00 | 0.01 | 0.02 | 0.09 | 0.10 | 0.10 | 0.12 | 0.10 | 1 |
| **Top 25 producers** | **4.02** | **5.86** | **8.07** | **9.95** | **10.52** | **10.64** | **10.74** | **10.13** | **88** |
| **Total all other producers** | **1.67** | **1.19** | **1.19** | **1.31** | **1.35** | **1.35** | **1.35** | **1.34** | **12** |
| **All producers** | **5.70** | **7.05** | **9.26** | **11.26** | **11.88** | **11.99** | **12.09** | **11.47** | **100** |
| **Inland water captures, by region** | | | | | | | | | |
| Asia | 2.87 | 4.17 | 5.98 | 7.39 | 7.85 | 7.90 | 7.89 | 7.29 | 64 |
| Africa | 1.47 | 1.89 | 2.33 | 2.87 | 3.01 | 3.02 | 3.24 | 3.21 | 28 |
| Americas | 0.56 | 0.54 | 0.58 | 0.57 | 0.59 | 0.64 | 0.55 | 0.53 | 5 |
| Europe | 0.28 | 0.43 | 0.36 | 0.40 | 0.41 | 0.41 | 0.39 | 0.42 | 4 |
| Oceania | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0 |
| Others[1] | 0.51 | – | | – | – | – | – | – | 0 |
| **World total** | **5.70** | **7.05** | **9.26** | **11.26** | **11.88** | **11.99** | **12.09** | **11.47** | **100** |

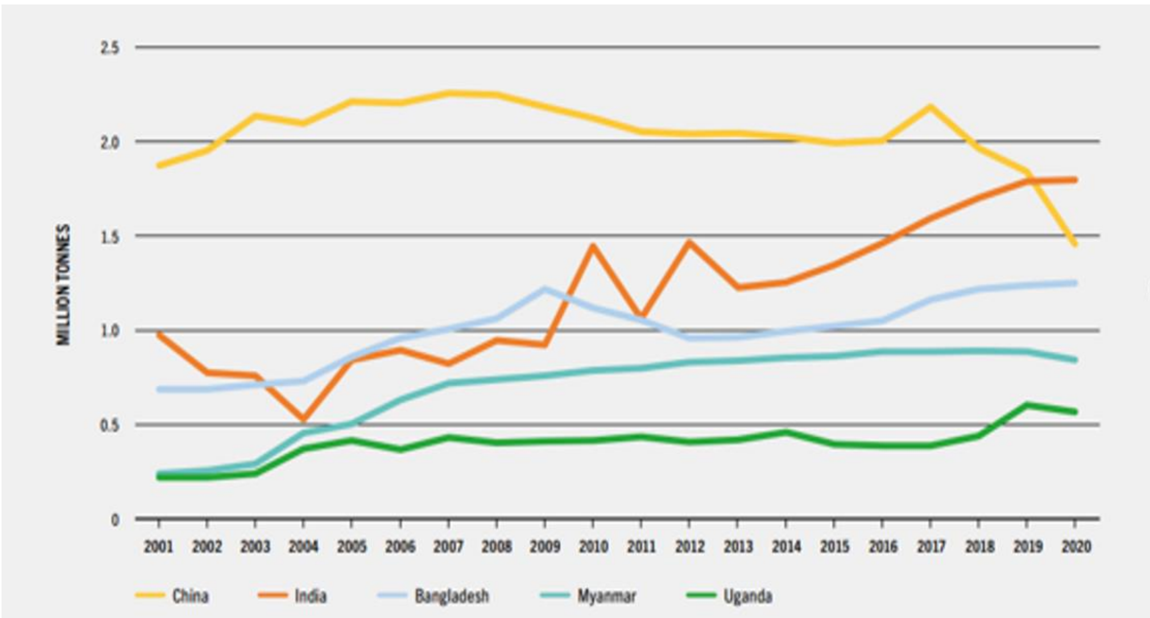
[1] Includes the Union of Soviet Socialist Republics.
NOTE: Excluding aquatic mammals, crocodiles, alligators, caimans and algae.
SOURCE: FAO.

The table shows that Asia was the largest producer of inland waterfish in 2020, accounting for 64% of global production. Africa followed it with 28%, and Europe with 5%. The top 25 producing countries accounted for 88% of global inland aquaculture production, whereas the remaining producers contributed 12%.

Among these top 25 countries, India led with 16%, followed by China with 13%, Bangladesh with 11%, and Myanmar with 7%. The other countries contributed between 1% and 4% each. Among Arab and African countries, Egypt stood out for having an inland aquaculture production share of approximately 3% of total global output in 2020 (FAO, 2022).

**7. Top five pond-based fish producers (FAO Report, 2022)**




The figure illustrates the top five producers of inland waterfish. As expected, China ranks first, with production exceeding 2 million tonnes. However, a decline was observed during the COVID-19 years beginning in 2018, continuing until 2020, when production fell below 1.5 million tonnes. This decline explains why India surpassed China during this period, as reflected in the previous table, with India accounting for 16% of global inland water production in 2020.

Bangladesh is in third place, followed by Myanmar and Uganda in fifth place (FAO, 2022).

**8. Global Aquaculture Production, 1991–2020 (FAO Report, 2022)**

The figure presents the evolution of global aquaculture production from approximately 20 million tonnes in 1992 to over 120 million tonnes in 2020. This significant growth highlights increasing global interest in aquaculture as a reliable source for food security and dietary diversification, owing to its many benefits. The figure also displays the development of different animal species and crustaceans, algae, and molluscs (FAO, 2022).

**9. Global Production and Growth (FAO Report, 2022)**

TABLE 6 WORLD AQUACULTURE PRODUCTION AND GROWTH

| | 1990–2020 | 1990–2000 | 2000–2010 | 2010–2020 | 2015–2020 |
|---|---|---|---|---|---|
| **All aquaculture** | | | | | |
| A. Starting annual output (million tonnes) | 17.3 | 17.3 | 43.0 | 77.9 | 104.0 |
| B. Ending year's annual output (million tonnes) | 122.6 | 43.0 | 77.9 | 122.6 | 122.6 |
| C. Accumulated increase in annual output (million tonnes) | 105.3 | 25.7 | 34.9 | 44.6 | 18.6 |
| D. Overall increase | 609% | 149% | 81% | 57% | 18% |
| E. Average annual growth rate | 6.7% | 9.5% | 6.1% | 4.6% | 3.3% |
| **Aquatic animals** | | | | | |
| A. Starting annual output (million tonnes) | 13.1 | 13.1 | 32.4 | 57.8 | 72.9 |
| B. Ending year's annual output (million tonnes) | 87.5 | 32.4 | 57.8 | 87.5 | 87.5 |
| C. Accumulated increase in annual output (million tonnes) | 74.4 | 19.3 | 25.3 | 29.7 | 14.6 |
| D. Overall increase | 569% | 148% | 78% | 51% | 20% |
| E. Average annual growth rate | 6.5% | 9.5% | 5.9% | 4.2% | 3.7% |
| **Algae** | | | | | |
| A. Starting annual output (million tonnes) | 4.2 | 4.2 | 10.6 | 20.2 | 31.1 |
| B. Ending year's annual output (million tonnes) | 35.1 | 10.6 | 20.2 | 35.1 | 35.1 |
| C. Accumulated increase in annual output (million tonnes) | 30.9 | 6.4 | 9.6 | 14.9 | 4.0 |
| D. Overall increase | 736% | 153% | 90% | 74% | 13% |
| E. Average annual growth rate | 7.3% | 9.7% | 6.7% | 5.7% | 2.5% |

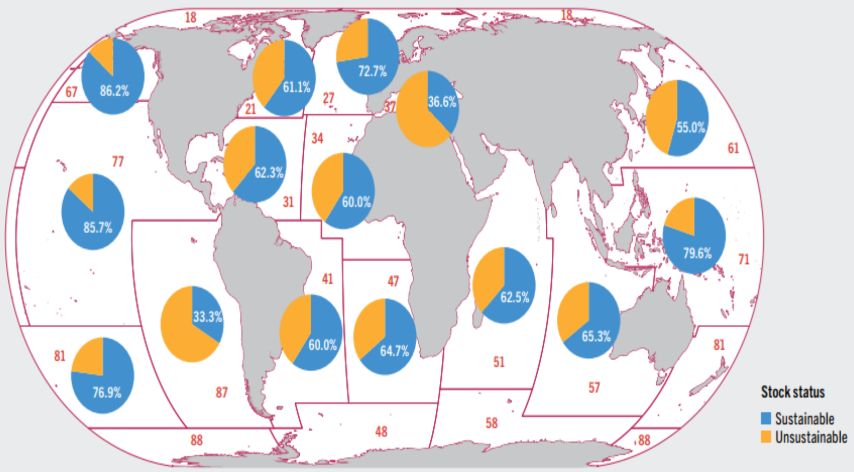
SOURCE: FAO.

The table shows that aquaculture production increased by 18% between 2015 and 2020, with an average annual growth rate of 3.3%. The growth in animal-based aquaculture has reached 20%, with an annual rate of 3.7%, whereas algae production has increased by 13%, corresponding to an annual growth rate of 2.5% (FAO, 2022).

**10. Permanent and Non-Permanent Biological Fish Stocks (FAO Report, 2022)**

Despite the crucial role of fish as a food source for communities, there is a pressing need to intensify research on aquaculture and its impact on natural fish stocks worldwide. Without such measures, aquaculture may pose ecological threats to the biological sustainability of global fisheries. The graph presents data on the proportions of permanent and nonpermanent fish stocks, offering insight into the current state and sustainability of global fish resources (FAO, 2022).

FIGURE 24 PERCENTAGES OF BIOLOGICALLY SUSTAINABLE AND UNSUSTAINABLE FISHERY STOCKS BY FAO MAJOR FISHING AREA, 2019




NOTE: The digital percentages represent the proportion of sustainable stocks.
SOURCE: FAO.

**Conclusions.**

Fish farming is among the key activities that significantly contributes to food security and environmental sustainability, particularly when integrated with agriculture. Integrated aquaculture provides water enriched with organic matter that benefits various crops, and it supports complementary feeding systems with animals such as ducks and poultry.

China is considered the country of origin for modern aquaculture and remains the most significant contributor to global fish production. In contrast, Algeria has recently initiated investment in this sector by offering financial support and loans to young entrepreneurs to enhance fish farming and the broader cultivation of aquatic organisms.

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