

Introduction to Aquaculture

Introduction to Aquaculture

Key concepts, benefits, challenges, and basic practices

1. What Is Aquaculture?

Definition	Scope
Aquaculture – the controlled cultivation of aquatic organisms (fish, crustaceans, mollusks, algae, and aquatic plants) for food, restoration, research, or commercial products.	Includes freshwater, brackish, and marine systems; land-based tanks, ponds, cages, recirculating systems, and integrated multitrophic setups.

2. Historical Background

Period	Milestones
Pre-historic	Evidence of fish ponds in ancient China (~4000 BC) and Egypt.
Roman Empire	Large-scale fish farms (e.g., <i>piscinae</i>) for mullet and sea bass.
19th-century	Scientific description of fish nutrition; first modern hatcheries in Europe & North America.
Mid-20th-century	Expansion of marine cage culture (e.g., salmon in Norway).
Late 20th–21st century	Rise of intensive recirculating aquaculture systems (RAS), offshore cages, and integrated multitrophic aquaculture (IMTA).

3. Why Aquaculture Matters

3.1 Food Security

- Provides >50% of the world's fish for human consumption.
- Faster growth rates than many terrestrial livestock (e.g., tilapia reaches market size in 6–8 months).

3.2 Economic Benefits

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- Generates employment in rural and coastal communities.
- High export value for species such as salmon, shrimp, and pangasius.

3.3 Environmental Services

- Can relieve fishing pressure on wild stocks.
- Certain systems (e.g., seaweed-based IMTA) absorb nutrients and mitigate eutrophication.

3.4 Research & Biotechnology

- Model organisms for genetics, disease studies, and vaccine development.
- Source of bioactive compounds (e.g., omega-3 fatty acids, pigments).

4. Main Types of Aquaculture Systems

System	Typical Species	Environment	Key Features
Pond Culture	Carp, tilapia, catfish	Freshwater, earthen or lined ponds	Low-tech, seasonal production, easy to scale.
Cage / Net Pen	Salmon, tuna, seabass	Open water (lakes, coastal seas)	High stocking density, uses natural water flow.
Recirculating Aquaculture Systems (RAS)	Trout, barramundi, shrimp	Indoor tanks with water treatment	Near-closed loop, precise control of water quality, minimal land use.
Integrated Multitrophic Aquaculture (IMTA)	Fish + shellfish + seaweed	Marine or brackish	Waste from fed species is utilized by extractive species, improving sustainability.
Aquaponics	Tilapia, leafy greens	Combined fish tanks + hydroponic beds	Symbiotic plant-fish production, suitable for urban settings.

5. Basic Biological Requirements

Parameter	Importance	Typical Range (for most warm-water species)
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Temperature	Metabolic rate & growth	22–30°C
Dissolved Oxygen (DO)	Respiration, stress reduction	>5mg/L ¹
pH	Enzyme	