

Introduction to Aquaculture

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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 ornamental purposes. • Often called “fish farming” but includes non?fish species (e.g., shrimp, seaweed, oysters). • Complements wild capture fisheries and helps meet the growing global demand for protein.	Encompasses ponds, tanks, cages, raceways, recirculating systems, and integrated multitrophic setups.

2. Historical Overview

Period	Milestones
Pre?modern (? 3000?BC – 1800?AD)	Early rice?fish polyculture in Asia; oyster beds in Europe.
Industrial era (1800–1950)	Development of large?scale ponds in the U.S., China, and Japan.
Green Revolution (1960s–1980s)	Introduction of high?yield species (e.g., <i>Oreochromis niloticus</i> Nile tilapia) and modern hatchery techniques.
Recent decades (1990s–present)	Expansion of recirculating aquaculture systems (RAS) , marine cage farms , and integrated multi?trophic aquaculture (IMTA) .

3. Why Aquaculture Matters

Economic	Social	Environmental
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- Generates >20% of global fish consumption (120 Mt/year).
 - Provides jobs in rural/coastal communities.
- Improves food security and nutrition (high-quality protein, omega-3 fatty acids).
 - Supports livelihoods of small-scale farmers.
- Relieves pressure on wild stocks.
 - Can restore degraded habitats (e.g., oyster reefs).
 - Offers opportunities for carbon sequestration (seaweed).

4. Main Production Systems

System	Typical Species	Habitat	Key Features
Pond Culture	Tilapia, carp, catfish	Freshwater (earthen or lined)	Simple, low-tech; water quality managed by aeration, fertilization.
Raceway / Flow-through	Trout, salmon (juveniles)	Freshwater channels with continuous flow	High stocking density; relies on natural water supply.
Cage / Net-pen	Salmon, sea bass, shrimp	Marine (coastal or offshore)	Uses existing water body; requires robust mooring and monitoring.
Recirculating Aquaculture Systems (RAS)	Tilapia, barramundi, shrimp	Indoor tanks (land-based)	Near-closed loop; water reused after filtration, temperature, O ₂ control.
Integrated Multi-Trophic Aquaculture (IMTA)	Fish + shellfish + seaweed	Marine or brackish	Species at different trophic levels recycle nutrients, reducing waste.
Off-shore/Deep-water Cages	Salmon, tuna	Open ocean (>30 m depth)	Reduced disease risk, larger scale, higher capital cost.

5. Basic Biological Requirements

Parameter	Importance	Typical Range (for most warm-water species)
Temperature	Metabolic rate, growth	20