

Introduction to Aquaculture

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Key concepts, benefits, challenges, and basic practices

1. What is Aquaculture?

Definition	Scope
Aquaculture = the cultivation of aquatic organisms (fish, crustaceans, mollusks, algae, and aquatic plants) under controlled conditions.	Includes freshwater , brackish , and marine environments; covers production , processing , and management of aquatic species.

2. Historical Background

Era	Milestones
Pre-historic	Evidence of fish ponds in ancient China (? 4000?BC) and Egypt.
Classical antiquity	Roman and Greek fish farms; “piscinae” for mullet and carp.
Middle Ages	Monastic carp ponds in Europe; rice-fish integrated systems in Asia.
20th-century	Scientific breeding, hatchery technology, and industrial scale farms.
21st-century	Sustainable intensification, recirculating systems, and offshore cages.

3. Why Aquaculture Matters

Economic	Environmental	Social
- Provides >50% of global fish for human consumption. - Generates jobs in rural/coastal communities.	- Relieves pressure on wild fisheries. - Can restore degraded habitats (e.g., shellfish reefs).	- Improves food security and nutrition (high-quality protein, omega-3). - Supports cultural traditions (e.g., tilapia in Africa).

4. Main Types of Aquaculture Systems

System	Typical Species	Key Features
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Extensive ponds	Carp, tilapia, catfish	Low input, large area, natural productivity.
Intensive tanks / Recirculating Aquaculture Systems (RAS)	Salmon, trout, shrimp, seaweed	High stocking density, water reuse, precise control of temperature, oxygen, waste.
Cage culture (pond, lake, sea)	Salmon, tuna, sea bass	Utilizes natural water bodies; moderate to high production.
Integrated Multi-Trophic Aquaculture (IMTA)	Fish + shellfish + algae	Waste from fed species is captured by extractive species, improving nutrient efficiency.
Polyculture	Carp + duckweed, shrimp + seaweed	Multiple species share the same water column, reducing waste and disease risk.

5. Core Biological Processes

Process	Relevance to Aquaculture
Reproduction & Hatchery	Controlled breeding ? uniform seed stock, disease-free larvae.
Growth & Nutrition	Species-specific feed formulations; feed conversion ratio (FCR) measures efficiency.
Health Management	Biosecurity, vaccination, probiotic use, water quality monitoring.
Molting / Metamorphosis (for crustaceans)	Timing of water parameters influences survival.
Reproduction of Algae	Light, nutrients, and CO ₂ control for biomass production.

6. Water Quality Parameters (the “ABCD” of Aquaculture)

Parameter	Ideal Range (species-dependent)	Why it matters
A – Ammonia (NH₃/NH₄⁺)	<0.02 mg/L ¹ (total) for most fish	Toxic in un-ionized form; indicates feed waste.