

Sustainable Aquaculture Practices

Sustainable Aquaculture Practices – Study Notes

1. Overview

- **Aquaculture** = cultivation of fish, crustaceans, mollusks, and aquatic plants.
 - **Sustainability goal**: meet present food demand while preserving ecosystem health, social equity, and economic viability.
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2. Core Principles of Sustainable Aquaculture

Principle	Key Objective	Typical Indicators
Environmental stewardship	Minimize habitat degradation, pollution, and resource depletion	Water quality metrics, feed conversion ratio (FCR), carbon footprint
Social responsibility	Ensure fair labor, community benefits, and cultural respect	Employment standards, local stakeholder engagement
Economic viability	Maintain profitability without compromising the other two pillars	Return on investment, market access, cost of inputs

3. Site Selection & Habitat Management

1. Environmental suitability

- Water temperature, salinity, dissolved oxygen, and flow regimes match species requirements.
- Avoid ecologically sensitive zones (e.g., mangroves, coral reefs, protected areas).

2. Carrying capacity assessment

- Use ecological modeling to estimate maximum sustainable stocking density.

3. Integrated multi-trophic aquaculture (IMTA)

- Co-culture species from different trophic levels (e.g., fish + shellfish + seaweed) to recycle nutrients.

4. Buffer zones & containment

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- Physical barriers, vegetated buffers, or offshore cages reduce escapees and disease spread.
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4. Feed Management

Strategy	Description	Benefits
Alternative protein sources	Insect meal, algal protein, single-cell proteins, fermented plant meals	Lower reliance on wild fishmeal, reduced pressure on marine stocks
Precision feeding	Automated feeders, real-time monitoring of feeding behavior	Decreases feed waste, improves FCR (typically 1.1–1.5 for salmon)
Nutrient-balanced formulations	Adjust amino acid, lipid, vitamin, and mineral levels to species needs	Enhances growth, reduces excess nitrogen/phosphorus discharge
Feed additives	Probiotics, enzymes, immunostimulants	Improves gut health, disease resistance, and feed efficiency

5. Water Quality & Waste Management

- **Monitoring tools:** inline sensors (pH, temperature, dissolved oxygen, turbidity), remote sensing, and data loggers.
 - **Recirculating Aquaculture Systems (RAS)**
 - Closed-loop water treatment (biofiltration, UV/ozone disinfection, degassing).
 - Typical water reuse > 95%; dramatically reduces effluent.
 - **Effluent treatment**
 - Settling ponds, constructed wetlands, or biofilters to remove suspended solids and nutrients.
 - **Bioremediation**
 - Use of seaweed or filter-feeding bivalves to absorb dissolved nutrients.
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6. Disease Prevention & Biosecurity

1. Health management plan

- Regular health checks, vaccination (where available), and parasite control.

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2. Genetic stewardship

- Use of locally adapted, disease-resistant strains; avoid excessive inbreeding.

3. Biosecurity protocols

- Controlled access, disinfection stations, quarantine of new stock.

4. Environmental control

- Maintain optimal stocking densities and water flow to reduce stress.
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7. Energy Use & Climate Impact

- Renewable energy integration

- Solar panels for pumps and lighting, wind turbines for offshore farms.

- Energy-efficient equipment

- Variable-speed pumps, low?