
Aquaculture
The farming of freshwater and marine plants and animals.
Photograph by HBOI

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Phases of Aquaculture

Harvest & Market

Broodstock Management

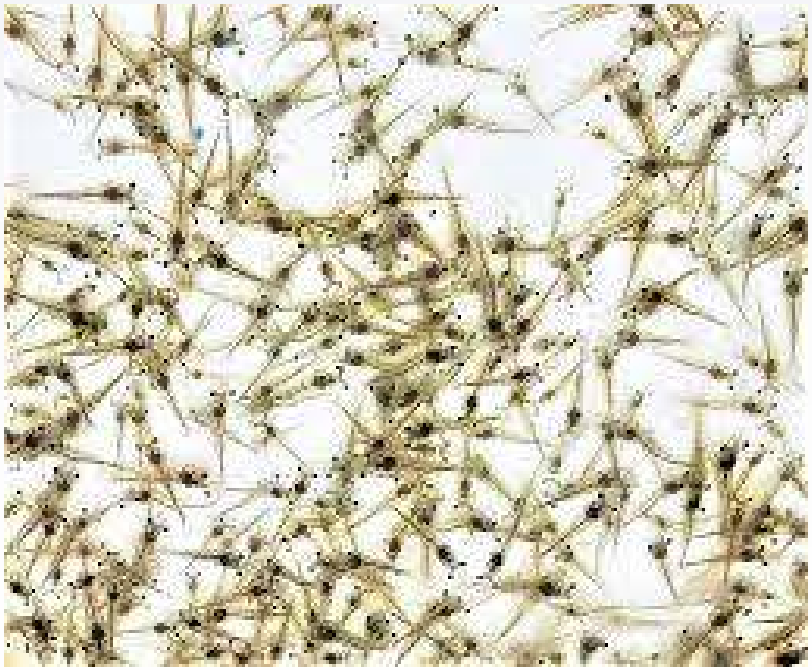
Hatchery Production

Grow-out

Nursery Production

Photographs by HBOI

Larva ikan



Methods of Cultivation
Extensive vs. Intensive

***Intensive* =**

- Maximize production
- Limited space
- High density
- Complete diet
- High water exchange

***Extensive* =**

- Utilize natural productivity
- Low density
- No or supplemental feeds
- Low water exchange

Metode akuakultur

Kolam tanah

bak fiber

Intensity of culture operations

- Classification
  - ✓ Intensive
  - ✓ Extensive
  - ✓ Semi-intensive

Intensity of culture operations

- Extensive systems
  - ✓ Relies on natural ecosystem processes for maintenance of water quality and provision of most nutrients
  - ✓ Thus, limited energy input is needed to maintain animal growth and survival
  - ✓ Low stoking densities
  - ✓ Common structures for extensive culture include ponds (“low value” fish – carp, tilapia) and substrate (bivalves, seaweeds)

Intensity of culture operations

- Intensive systems
  - ✓ Requires high energy input (feeds, aeration, water filtration, water pumping, etc.)
  - ✓ No energy recycling (totally non-self-supporting)
  - ✓ All nutrition comes from introduced feeds, with no utilization of natural diets
  - ✓ Simple food chain: feed → cultured organism
    Thus, low energy losses/high feed conversion ratios
  - ✓ High rearing densities and production yields (per unit volume or area)
  - ✓ Water quality requirements for target species determines level of stocking (stocking: ponds < cages < raceways/tanks).
  - ✓ Use of ponds, (shrimp), cages (marine fish), raceways (trout), tanks (eels) – but remember that usually different structures are used depending on growth stage of cultured species.
  - ✓ Can be outdoor or indoor

Intensity of culture operations

- Intensive versus extensive systems

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Table 2.1 Comparison of the general characteristics of extensive and intensive aquaculture systems

	Extensive aquaculture	Intensive aquaculture
Establishment costs	Low	High
Culture systems used	Natural water bodies and simple containment structures	Fabricated culture systems, including tanks, pond systems, raceways, seacages, etc.
Technology level	Low	High
Degree of control over the	Very low	High
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Monitoring of water quality	[illegible]	[illegible]
Food source for cultured animals	Natural food organisms; often some input of animal and plant wastes	Pelletised, fabricated feeds, which must be nutritionally complete
Production (kg/ha/year)	Low (per unit area or volume) (20–500)	High: maximising output of product in minimum surface area, water volume and time 5000–100 000+*
Production costs	Low to very low	High to very high

*The highest values are extrapolations from square metres.

Intensity of culture operations

- Semi-intensive systems
  - ✓ There is no clear line separating intensive from extensive culture
  - ✓ Middle ground = semi-intensive
  - ✓ Semi-intensive culture systems rely to some degree on natural processes and productivity, but there is also supplementation, such as
    - ➢ Aeration
    - ➢ Addition of fertilizers (organic or inorganic)
    - ➢ Addition of feeds (supplemental feeds)
  - ✓ Semi-intensive culture is almost exclusively applied in ponds and allows for increase in stocking density relative to extensive systems

Water exchange/flow systems

- Classification
  - ✓ Static
  - ✓ Open
  - ✓ Semi-closed
  - ✓ Recirculating (closed)

Water exchange/flow systems

- Static systems
  - ✓ Static system is one in which there is no water replacement during the growth of an organism (except for water added to offset evaporation)
  - ✓ Static pond culture is usually extensive because of difficulties in maintaining water quality
  - ✓ Most global aquaculture occurs in ponds using static systems

Aquaculture Systems

- Open
  - Netpens, cages, longlines, bottom culture
- Semi-closed
  - Ponds, raceways, tanks
- Closed
  - raceways, tanks

Aquaculture systems: Open

- Organisms are reared in natural systems
- No diversion or pumping of water
- Floating netpens, floating racks, longlines, on-bottom culture

Water exchange/flow systems

- Open systems
  - ✓ The open environment (lake, ocean, etc.). There is no artificial circulation of water through or within the system.
  - ✓ Structures used in this system include cages, racks, etc.
  - ✓ In some cases, such as salmon culture in cages, the open system is intensive (high density of fish with artificial feeds)
  - ✓ In other cases, such as bivalve culture in racks, the open system is extensive (bivalves feed on plankton)
  - ✓ Operation costs of open system is usually low since no pumping is required
  - ✓ Capital costs are high for open intensive systems and low for open extensive systems.
  - ✓ Problems: (1) lack of control over water quality, so site selection is a very important consideration; (2) predation and disease.

Aquaculture systems: Semiclosed

- Organisms are reared in manmade impoundments
- Water is diverted from natural flows or pumped
- Examples are ponds and raceways

Water exchange/flow systems

- Semi-closed systems
  - ✓ Systems where culture water is confined in discrete units and some degree of water exchange occurs are defined as semi-closed systems. These systems fall between static (no exchange) and open (in the open environment) systems in terms of water exchange.
  - ✓ Ponds, tanks and raceways where significant exchange of water are carried out are considered as semi-closed systems.
  - ✓ Since the farm is not located in the natural environment, there is some control over water quality by regulating the amount exchanged.
  - ✓ In large semi-closed systems with semi-intensive to intensive culture, water flow is generally high (5-10% per day for semi-intensive ponds and 30-40% per day in intensive ponds)

Aquaculture systems: Closed

- Water is reused - little or no effluent
- Sophisticated water filtration and treatment
- Recirculating aquaculture systems, aquariums

Water Systems

- **Flow-through: one time use of water**
- **Recirculation: reuse of water**

Aquaculture systems: Flow-through

Pretreatment

Effluent

Photographs by HBOI

Flow-through aquaculture systems

Advantages

- Lower cost
- Simplicity
- Provides ambient food
- Requires lower skill level

Disadvantages

- No environmental control
- Source of contaminants, pollutants
- Greater regulatory constraints

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Aquaculture systems: Recirculating

Pretreatment

Rearing Tank

Post treatment Effluent

Photographs by HBOI

Recirculating aquaculture systems

Advantages

- Environmental control
- Free of outside contaminants
- Fewer regulatory constraints

Disadvantages

- Higher costs
- Higher skill level
- Complex system, potential problems
- Must provide all feed
- Buildup of toxins & pathogens

Water exchange/flow systems

- Recirculating (closed) systems

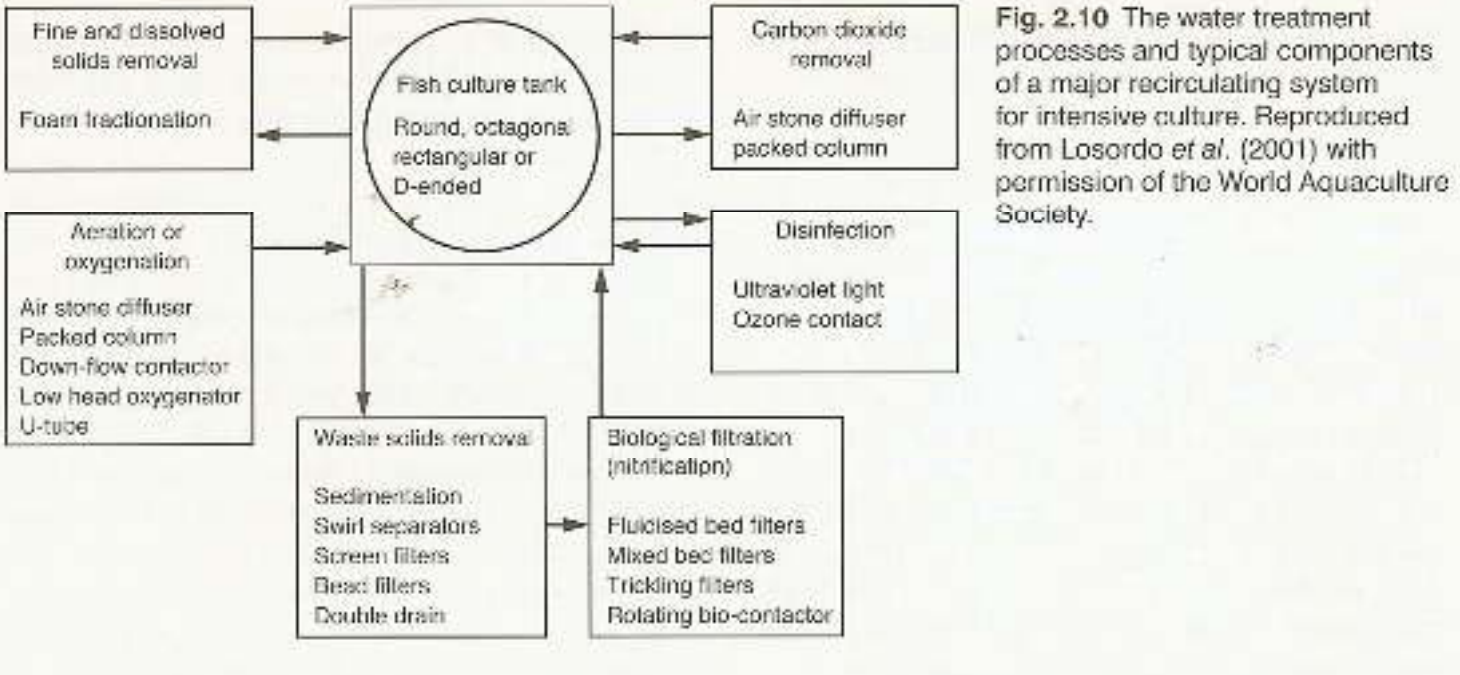

Fig. 2.10 The water treatment processes and typical components of a major recirculating system for intensive culture. Reproduced from Losordo *et al.* (2001) with permission of the World Aquaculture Society.

Pond culture.

- Earthen pond or lined pond.
- Static or water exchanged.
- Uses tides or gravity flow or water pumps.

Kolam

Kolam Tanah

- Kolam Semi Permanen

Kolam Permanen

KOLAM BERDASAR VOLUME PERGANTIAN AIR

Kolam air tenang

Kolam air deras

BAK

Bak Induk

- Bak beton volume 200 ton diameter 10 m dan kedalaman 3 m
- Bak berbentuk bulat dimaksudkan untuk mempermudah pemanenan telur

Bak pemeliharaan larva

- Terbuat dari semen, keuntungannya ialah mudah dalam pembuatan, tahan lama dan mudah dalam memperoleh bahan baku
- Ukuran dan bentuk bak tidak berpengaruh langsung terhadap larva :
  - Bak bulat kurang efisien dalam pemanfaatan lahan
  - Bak ukuran kecil sulit untuk menjaga kestabilan suhu
  - Bak besar sulit dalam pengelolaan

Tank Culture.

- Concrete, fiberglass or lined?
- Indoor or outdoor?
- Static or water exchange?

Tank Culture.

- Concrete, fiberglass or lined?
- Indoor or outdoor?
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Karamba Jaring Apung

Cage culture.

- Usually in natural water bodies.
- Less mechanization and water quality control required.

natural catastrop

Bag culture.

- Also use natural water bodies.
- For sessile filter feeders (oysters, clams, mussels).

Sea Ranching.

- Oyster culture on bottom.
- Seeding of algae.
- Release of fry for harvest as adults.

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A
B
C
D


99.co

E.cottoni

Sargassum

Kelp (giant algae)