AQUACULTURE I

12. WEEK

AQUACULTURE IN RACEWAYS, CAGES, AND ENCLOSURES

WEEKLY TOPICS

WEEK	TOPICS
1. WEEK	WHAT IS AQUACULTURE?
2. WEEK	IMPORTANCE OF AQUACULTURE
3. WEEK	AQUACULTURE: ANIMAL PROTEIN
4. WEEK	HISTORY OF AQUACULTURE
5. WEEK	ORGANISATION OF AQUACULTURE
6. WEEK	CHARACTERISTICS OF AQUACULTURE
7. WEEK	POND CULTURE
8. WEEK	IN STATIC FRESHWATER PONDS
9. WEEK	IN BRACKISH-WATER PONDS
10. WEEK	RUNNING WATER CULTURE
11. WEEK	CULTURE IN RE-CIRCULATORY SYSTEMS (RAS)
12. WEEK	AQUACULTURE IN RACEWAYS, CAGES, AND ENCLOSURES
13. WEEK	MONOCULTURE AND POLYCULTURE
14. WEEK	RECENT ADVANCES IN AQUACULTURE

- In development of fish culture an increasing importance is given to the full utilization of water resources. The first step was to increase the natural yield of existing waters, followed, as a second step, by the construction and use of ponds to fulfill the requirements of industrial-type fish culture. Then came the real breakthrough, with the construction of so called flow-through systems, where not the size of the water area but the quantity of water flowing through limited the yield.
- The earlier principle then had to be revised, since the water area did not limit the amount of fish produced, but the volume of water supplied did.

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- Fish culture in flow-through systems is a type of intensive culture where the fish are stocked densely in a long and narrow pond or tank in which there is an abundant continuous water flow. The fish are stocked in these ponds or tanks on the basis of the volume of inflowing water. They are fed a formulated pelleted food and usually this is their only source of nutrition. A continuous water flow ensures the proper oxygen supply to the fish and flushes away the metabolic wastes.
- The flow-through system is a typical and traditional facility for trout culture, but other species can also be cultivated in this type of system with good results.

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- WATER SUPPLY

- Conventional Flow-Through Systems
- Intensive Flow-Through Systems

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- Among all systems of fish culture, the flow-through system depends to the highest degree upon an abundant and continuous water supply.
- In a conventional flow-through system the oxygen requirement of the fish is supplied by the inflow water. The water flow rate that is needed for proper oxygen supply of the fish usually is larger than is required for flushing the metabolic wastes. Thus, in a conventional flow-through system the water flow rate should be calculated on the basis of the oxygen requirement of the fish. Recently, intensive flow-through systems have been designed in order to increase the stocking density or to decrease the water flow. In these systems the oxygen requirement of the fish is met by oxygenation of the inflow water. When the water flow rate of an intensive flow-through system is calculated, the flow rate that is needed for the flushing of the metabolic wastes becomes the critical factor.

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- THE FUNDAMENTALS OF THE DESIGN OF FLOW-THROUGH SYSTEMS

- Water Pumping System
- Tank Design
- Size
  Material
  Additional equipment

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- The tanks of a flow-through system usually are rectangular reinforced concrete raceways, but large size outdoor raceways can be made of earth with plastic covered inner surface. Smaller size indoor raceways can be built out of concrete, plastic, metal or wood.

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- The tanks should be equipped with properly designed water control structures and it is advisable to install a safety device as well that gives an alarm signal when the water flow (or the water level) decreases below a certain value.
- Although the conventional flow-through system is based upon the oxygen supply from the inflow water, in extreme cases oxygen depletion can occur. Then aeration is needed. Therefore emergency aerators with high efficiency should be provided during the design of the farm equipment.
- In flow-through systems, intensive feeding is based on complete pelleted food that should be given to the fish regularly and in proper doses. This can be ensured by different automatic feeders first of all, but self moving food dispensers or demand feeders can also be used.

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- Regular grading is an essential work in these intensive systems, because the divergence in the growth rate has a disadvantageous effect on the growth of the smaller fish. Special mechanized graders are available for this purpose that handle the fish gently; however, the frequency of the grading should be minimized.
- Because of the special conditions of these systems (high stocking density, concrete tank, etc.) the harvest of the fish can be mechanized as well.
- Different fish pumps have been developed for this purpose.

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- Origin and spread of cage culture techniques; advantages (minimal space requirement, very high production per unit area, facility for towing off in case of pollution, safety from predators, suitability for culturing large variety of species, facility to use areas where sea bed is unsuitable for farming, ease of harvest, etc.) and disadvantages (high demand on oxygen and water flow, dependence on artificial feed, food losses, pollution, rapid spread of disease, risk of theft, conflict with multiple use of natural waters, etc.).
- Types of cages
- Cages occupying the whole water column (from surface to bottom), floating cages, mid-water cages with buoyed "feeding neck" and bottom cages; single and multiple units, rigid and flexible cages; self-supporting and raft-supported cages; selection of type of cage in relation to conditions at farm site.

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- Design and construction
- Selection of site
- Layout
- Cages, jetties, walkways, buildings for feed preparation and preparation of fish for market; hatchery and nursery pond (where needed).
- Construction
- (a) Framework; materials used (wood, bamboo, galvanized scaffolding, aluminium, etc.); support and lifting ropes; frameless cages; shape of net.
- (b) Walls, bottom and roof; mesh netting of natural fibre, synthetic fibre, galvanized chain-link or galvanized weld mesh; site fouling tests with different materials to select the material most suited to the area.
- (c) Flotation structure: use of rigid collars of metal or plastic (air-filled, foam-filled or fibre-filled), discrete buoys or polydrums.
- (d) Linkage of multiple units.
- (e) Mooring and anchoring.
- (f) Construction of water-breaking structures.
- (g) Shapes and dimensions; determination of shape and size in relation to hydrographical conditions, species to be stocked, stocking rate, production target, etc.; relative merits and demerits of large and small cages.

http://www.fao.org/docrep/t9805e/t9805e0b.htm#x. cage culture

- **Macintosh (1994),** Lagoon fisheries production can be enhanced significantly through aquaculture, provided appropriate culture sites and species are selected. Salinity is the most important environmental variable in lagoons affecting the scope for aquaculture but, increasingly, habitat degradation, eutrophication and pollution are adding to the limitations on aquaculture in lagoon systems. Examples of culture methods operating in lagoons, including fish cages, pens for milkfish and shrimp, mollusc rearing on artificial substrates, and seaweed production are described, with emphasis on their environmental requirements and constraints. Some socio-economic problems involving aquaculture development in lagoons, compatibility with other uses of lagoons, and the special relationship between aquaculture and lagoon capture fisheries are discussed

Macintosh, D. J. (1994). Aquaculture in coastal lagoons. In *Elsevier Oceanography Series* (Vol. 60, pp. 401–442). Elsevier.

- References

- Regional Review On Status And Trends In Aquaculture Development In Europe – 2015, Fao Fisheries And Aquaculture Circular No. 1135/1 Fiaa/C1135/1 (En)
- The State Of World Fisheries And Aquaculture 2016, Fao. 2016
- Advances In Aquaculture Hatchery Technology 2013, Woodhead Publishing Series In Food Science, Technology And Nutrition: Number 242
- Aquaculture: An Introductory Text, 2005, Robert R. Stickney
- Aquaculture Farming Aquatic Animals And Plants,2012, John S. Lucas
- Emerson, K et al., 1975, Aqueous ammonia equilibrium calculations: effect of pH and temperature. J. Fish. Res. Board Can., 32(12):2379–83
- Kepenyes, J. and A. Ruttkay, 1983, Water requirement of fish production. In International Conference on Water management and production potential in agriculture. Szarvas, Hungary, pp. 90–100
- Kerr, NM, 1981, Design of equipment and selection of material – an engineer's assessment. Schr. Bundesforschungsanst. Fisch. Hamb.. (16/17) vol. 2:515–21
- Kramer, Chin and Mayo Inc., 1972, A study for development of fish hatchery water treatment systems. Prepared for Walla Walla District Corps of Engineers.
- Macintosh, D. J. (1994). Aquaculture in coastal lagoons. In *Elsevier Oceanography Series* (Vol. 60, pp. 401–442). Elsevier.