

Aquaculture Systems

EQF Level 5:

Guided learning hours:

Unit abstract

The aim of this unit is to equip students with a general knowledge of the most typical European and global aquaculture systems. Modern aquaculture systems play a very important role in the supply of fish for culinary purposes. Huge quantities of - mostly - market size fish are produced under industrial circumstances.

As a result of decreasing natural catch of salt-water and freshwater fish, there is an increasing market demand for aquaculture products in Europe. Therefore spread of European aquaculture systems have speeded up.

Learning outcomes

On successful completion of this unit a learner will:

1. Understand the spread and characteristics of aquaculture systems
2. Understand global and European trends
3. Understand the operation of aquaculture systems
4. Understand the set up (construction) of aquaculture system

Unit content

1. Understand the spread and characteristics of aquaculture systems

advantages of aquaculture systems: fish quantity, predators, less water, short period of breeding, independence of seasons;

development of aquaculture systems:

waste water treatments: aquaponic systems, wetlands (ponds), multi-tropic system, open field cultures

chemical factors: dissolved oxygen, salinity, carbon dioxide, nitrogenous wastes, alkalinity, hardness, pH, iron, chlorine, hydrogen sulfide, water clarity;

Definition of aquaculture: farming of aquatic organisms such as fish, crustaceans, mollusks and aquatic plants aquaculture involves cultivating freshwater and salt-water populations under controlled conditions, and can be contrasted with commercial fishing, which is the harvesting of wild fish.

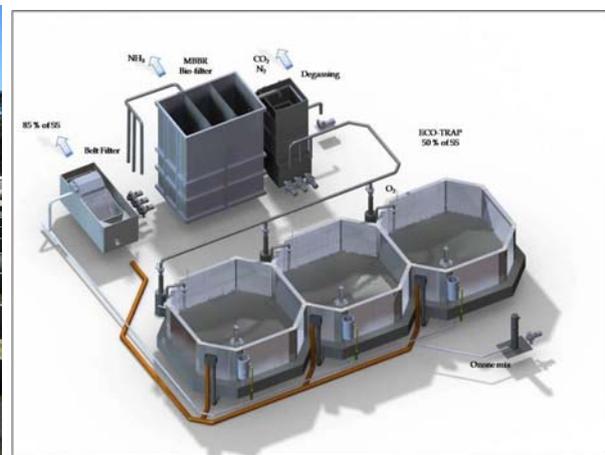
2. Understand global and European trends

Europe and global aquaculture production (focus on Asia); Aquaculture products; Decrease of aquaculture products

3. Understand the operation of aquaculture systems

salt-water cage systems; freshwater systems; aquaponic systems; flow through systems; recirculation systems; using geothermal energy; multi-tropic systems; salt-water species; freshwater species; specific requirements of feed, water quality and quantity, temperature, light hours, breeding methods and timing;

In traditional **flow-through** aquaculture systems, water passes through the culture system only once and is then discharged back to the aquatic environment. The flow of water through the culture system supplies oxygen to the fish and carries dissolved and suspended wastes out of the system. The most widely-practiced form of flow-through aquaculture in Europe is trout farming. Water is taken from the river, circulated through the farm and treated before being released downstream. All water in the farm is renewed at least once per day. Where more than one farm exists on the same river, it is in everyone's interests that the quality of the outflowing water from one farm is good, as this then becomes the inflowing water for the next farm. Trout production is spread throughout Europe and fresh trout can be bought everywhere. Because of its growth requirements and production performance, rainbow trout (*Oncorhynchus mykiss*) largely dominates European trout production (approximately 95% of the total production). Most of the EU member states have trout farms near to rivers, and use concrete basins or ponds. Some lake cages are also in use.



Recirculation Aquaculture Systems (RAS) are land-based systems in which water is re-used after mechanical and biological treatment so as to reduce the need for water and energy and the discharge of nutrients to the environment. These systems present several advantages, such as: water saving, a rigorous control of water quality, low environmental impacts, high biosecurity levels and an easier control of waste production as compared to other production systems. The main disadvantages are high capital costs, high operational costs, requirements for very careful management (and thus highly skilled labour forces) and difficulties in treating disease. RAS is still a small fraction of Europe's aquaculture production and is most significant in the Netherlands and Denmark. The main freshwater species produced in RAS are catfish and eel but other species are

already being produced using this type of technology. The eel production in the EU was around 11 000 tonnes/year up to 2001, and then it dropped to approximately 8 500 tonnes/year from 2002 and has stabilised overall since. However, this figure hides major shifts among the main producers.

Well designed and carefully managed **cage** cultures also provide limited but important possibilities for freshwater aquaculture. In certain water bodies, extensive or intensive production of fish in cages can be in line with the sustainable use of natural resources. For instance, Arctic charr (*Salvelinus alpinus*) farming is at present a small but successful business in Sweden and is expected to increase considerably over the coming years. These farms are located in the mainly unexploited regulated lakes and waterpower reservoirs along the dammed rivers in the northern parts of the country. These waters were naturally poor in nutrients, but, following water regulation, have been further nutrient depleted to what are now almost sterile conditions.

Farming fish in these waters would represent a restoration action as the increased amount of nutrients would serve to bring the aquatic environment closer to the natural state. It requires an annual production of at least 5 000 tonnes Arctic charr to increase the present level of phosphorus of 3 µg/l to an estimated 'original level' of 10 µg/l in these lakes.



Aquaponics or **piscaponics** is a sustainable food production system that combines a traditional aquaculture (raising aquatic animals such as snails, fish, crayfish or prawns in tanks) with hydroponics (cultivating plants in water) in a symbiotic environment. In aquaculture, effluents accumulate in the water, increasing toxicity for the fish. This water is led to a hydroponic system where the by-products from the aquaculture are broken down by nitrogen fixing bacteria, then filtered out by the plants as vital nutrients, after which the cleansed water is recirculated back to the animals.

4. Understand the set up (construction) of aquaculture system

pumps; mechanical filter types; biological filtration types; water treatment systems; UV lamps; lights; field sizing; feeding systems; cage types; using ozone; system buildings; feeding systems; hatching systems; dissolved oxygen, monitoring systems

(Illustrations, pictures, characteristics of the main types of equipments)

Sources:

- Handbook for Sustainable aquaculture – Sustain Aqua/Haki
- www.uvi.edu
- www.eatip.eu
- www.haki.hu
- www.fao.org