

Aquaculture & Sports Fisheries

Module
Aquaculture
Systems



EQF
Level
5

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Aquaculture Systems

EQF Level 5

Credit Value 10

Unit abstract

The aim of this unit is to equip students with a general knowledge of 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 marketable 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 the growth of European aquaculture systems has increased.

Recirculation systems are one of the most important and mostly cost-efficient systems, therefore a sound knowledge of them is highly important.

Learning outcomes

On successful completion of this unit a learner will:

1. Discuss global and European trends in aquaculture
2. Understand the structure of a range of aquaculture systems
3. Understand the operation of recirculation systems (rs)
4. Undertake the operation and variability of an aquaculture system

Unit Content

1. Discuss global and European trends in aquaculture

International (especially improving production of Asian countries) and European fish farming indices and indicators of the last 10 years according to the farming method (i.e. freshwater natural catch, marine natural catch, freshwater aquaculture, marine aquaculture)

European Fishery Policy (European Fisheries Fund, main regulations)

Global problems and aquaculture systems (importance of aquaculture systems globally)

Informational/statistical database ("Fishstat Plus", FAO), etc.) – utility, usage

2. Understand the structure of a range of aquaculture systems

Definition of aquaculture systems (industrial, controlled fish production in a permanent production that is independent or semi-independent from weather)

Characterization of different aquaculture systems: salt-water cage systems; freshwater systems; aquaponic systems; flow through systems; recirculation systems; 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, feed.

Significance of aquaculture systems: stable fish supply (fish kg/m³), freshwater predator production (better meat quality, higher market importance) water use, breeding strategies

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; phosphorous

Main equipment's of different aquaculture systems: pumps; mechanical filter types; biological filtration types; UV lamps; lights; field sizing; feeding systems; cage types; ozone; system buildings; feeding systems; hatching systems; dissolved oxygen, monitoring systems

3. Understand the operation of recirculation systems (rs)

Quality of incoming water for the RS: in particular with respect to specific sensibility of fish species

Understand influx and efflux of gases: gas dynamics, influx of O₂, demand- efflux of CO₂, air removal from the building

Transport of minerals through the fish farm: with respect to production of H⁺, NO₃⁻ and other salts (as measured by conductivity) mineral dynamics; influx of N-components and production of H⁺ and NO₃⁻

Install desired pH: in relation to water hardness and influx and efflux of culturing water

Determine best efflux (and influx) of culturing water: in relation to desired water hardness pH, NO₃⁻ and sludge to be removed; in detail: Adjust nitrate (NO₃⁻) to optimal levels (in relation to rate of effluent and rate of conversion into N₂); adjust optimal conductivity (in relation to rates of inflow and outflow and amount of added minerals); determine the rate of water replacement; remove NO₃⁻ and PO₄³⁻ from culturing water

Filtering capacity dimensioning a recirculation system: calculate necessary surface of full-grown bacteria in a fish production system (at a certain standing stock); understand the function and dimension of the sedimentation tank; understand the function and dimension of the oxidation ('trickling')filter

4. Undertake the operation and variability of an aquaculture system

fish quantity, breeding time, main parameters, cost analysis

design an appropriate aquaculture system for a selected species from construction to operation (fish, equipment's, feed, diseases, etc.)

Aquaculture systems: recirculation system, aquaponic system, cage system, flow-through system

Fish species: trout (*Salmo trutta*, *Onchorhynchus mykiss*), barramundi (*Lates calcarifer*), tilapia (*Sarotherodon nilotica*), African catfish (*Clarias gariepinus*), sander (**Sander lucioperca**), perch (*Perca fluviatilis*), red drum (*Sciaenops ocellatus*)

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria The learner can:
LO1 Discuss global and European trends in aquaculture	1.1 discuss recent trends of fish farming in international and European context 1.2 discuss the main aims of European Fishery Policy 1.3 access and analyze statistical data
LO2 Understand the structure of a range of aquaculture systems	2.1 determine an aquaculture system to defined circumstances and species 2.2 explain how to set up an aquaculture system 2.3 outline the critical control points
LO3 Understand the operation of recirculation systems (rs)	3.1 analyze quality of incoming and effluent water of the recirculation system 3.2 describe mineral and gas influx and efflux during fish production 3.3 explain filtering capacity
LO4 Undertake the operation and variability of an aquaculture system	4.1 identify the different types of aquaculture systems 4.2 select a fish species to suit a given aquaculture system 4.3 outline the operation of an aquaculture system

Guidance for Tutors

Delivery

Lectures, discussions, seminar presentations, site visits and supervised laboratory practical's, research using the internet and library resources, and the use of personal and/or industrial experience would all be suitable for the delivery of this unit. Delivery will also involve practical assessments, written assessment and visits to suitable collections and will link to work experience placements.

During delivery of this unit, it is essential that tutors stress the importance of aquacultural systems. Health and safety issues relating to working in a fish farm and using chemicals must be stressed and reinforced regularly, and risk assessments must be undertaken before any practical activities. Adequate personal protective equipment (PPE) must be provided and used following the production of suitable risk assessments. Apply the national and international codes of practice and legislations when working with fish.

Visiting expert speakers will add to the relevance of the subject for learners. For example, a fish farmer could talk about their work, the particular situations they face and the methods they use.

Essential requirements

Essential requirements: learners must assess the condition of a fish breeding unit. Learners must have access to the internet as well as to up-to-date literature on fish growing systems.. Fish must not be subjected to stress or overuse during delivery of this unit.

Employer engagement and vocational contexts

Delivery of this unit would be enhanced by the visits from relevant experts such as fish farmers and/or personnel from system builders. Learners would benefit from off-site visits to, for example, different types of husbandry and welfare of fish kept in controlled situations. Discussion on population density, in relation to productivity and welfare.

Links:

Health and welfare unit

Fish farming techniques

Tutors delivering this unit have following opportunities to indulge in: site visits, library resources and previous experience.

Health and safety issues relating to working in and around water must be stressed and regularly reinforced, and risk assessments must be undertaken prior to practical activities. Appropriate personal protective equipment (PPE) must be used during practical work (gloves). For performing calculations it is advised to use a professional

calculator. For determinations of water parameters it is necessary to use a professional test-kit.

Whichever delivery methods are used, it is essential that tutors stress the importance of animal welfare, sound environment management and the need to manage the resource using legal methods

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments learners may also be taking as part of their programme of study.