



## Recirculated Aquaculture Systems Advantages & Disadvantages

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# RAS – Advantages 1



Low water requirement

- can utilise small water sources and/or be connected to the public water supply

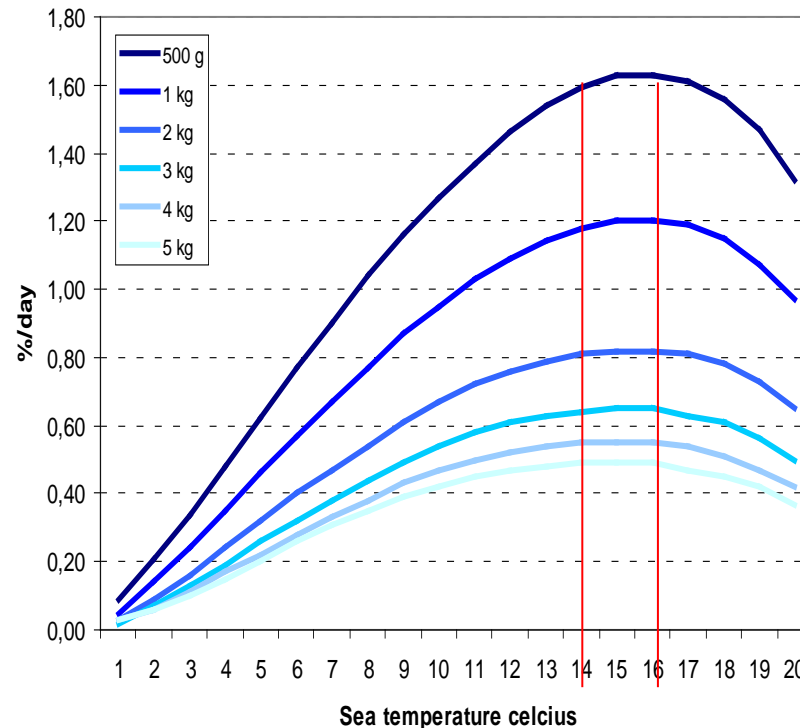
Type of farm	Liter new water per kg fish production
Traditional pond farming	40 - 50.000
Reuse – moderate	25.000
Reuse – intensive	10.000
Partly Re-circulation	5.000
Moderate Re-circulation	500
Intensive Re-circulation	50-400
1 kg beef	15.500
1 liter of milk	150
1 kg of pork	4.800
1 kg of chicken	3.900
1 kg of rice	3.400
1 kg potatoes	900

# RAS – Advantages 2



The system can achieve optimal temperature and enables optimal and stable production all year round, independent of seasonal variation, this makes the production predictable for 365 days

**Growth performance atlantic salmon**



# RAS – Advantages 3



The required area for a given production is relative small, because a very high density and a high growth rate is possible in the controlled environment

Fish size (gram per fish)	Density/Biomass (kg per m <sup>3</sup> water)	Numbers (pcs. per m <sup>3</sup> )
2	22	11.000
10	35	2.833
50	60	1.200
100	50	500
2.000	75	38
5.000	85	17

# RAS – Advantages 4



## Reduced risk of diseases

- All incoming water can be filtrated and afterwards UV-disinfected
- All entrance to the fish farm is through a disinfection room

## The incoming water can be further treated to achieve the desired quality

- If the water is not suitable for fish farming undesirable substances like iron, manganese, aluminium etc. can be feasible removed - because very little water is used

## Control and traceability

- PC Monitoring and Surveillance

## Optimal and stable production conditions

- Securing high and stable quality of the fish





# RAS – Advantages 5



Due to low water consumption in RAS also the discharged water volume is minimal and can be controlled and treated.

Sludge from the system can be concentrated to desired dry matter content and appear as an odour free fertiliser – or can be used in biogas-production .



**The fish farm can be established near cities and thereby close to market**

This means less transportation costs and less CO<sub>2</sub> footprint

The transportation costs for 1 kg fresh salmon from Norway to USA by airfreight is approx. 1½ US\$, to China app. 2 US\$

# RAS – Disadvantages 1

- Advanced system
- Security system in function at any time
- Regular power supply with back-up necessary
- RAS requires skilled staff for management



This require full focus on the daily routines.

# RAS – Disadvantages 2



The RAS is relative expensive to establish and has a relative high energy consumption. Therefore the RAS requires a minimum production capacity for an economical operation.

Type of farm	Liter new water per kg fish production	kWh pr kg fish produced per year (new-old)	Water treatment	Total investment per 1 kg production capacity
Traditional	50.000	0	None	?
Reuse – moderate	25.000	1-3	+ aeration + degassing of CO <sub>2</sub>	2 Euro
Reuse – intensive	10.000	1,5-5	Pure oxygen + mechanical filtration	2-3 Euro
Partly Re-circulation	5.000	1,5-3	+ biological filtration	3-4 Euro
Moderate Re-circulation	400 - 700	2-8	+ indoor +UV disinfection + temperature control	8-10 Euro
Intensive Re-circulation	50 - 400	2-8	+nitrate removal + phosphor removal +sludge thickening	10-12 Euro



# Definition of Re-Circulation



Water exchange per amount of feed put into the system per day is the most accurate definition.

$$\text{Water exchange per kg feed} = \frac{\text{Water exchange/day (m}^3\text{/day)}}{\text{Feeding/day (kg/day)}}$$

$$\text{Water exchange per kg feed} = \frac{120 \text{ (m}^3\text{/day)}}{300 \text{ (kg/day)}}$$

$$\text{Water exchange per kg feed} = 400 \text{ l/kg feed}$$

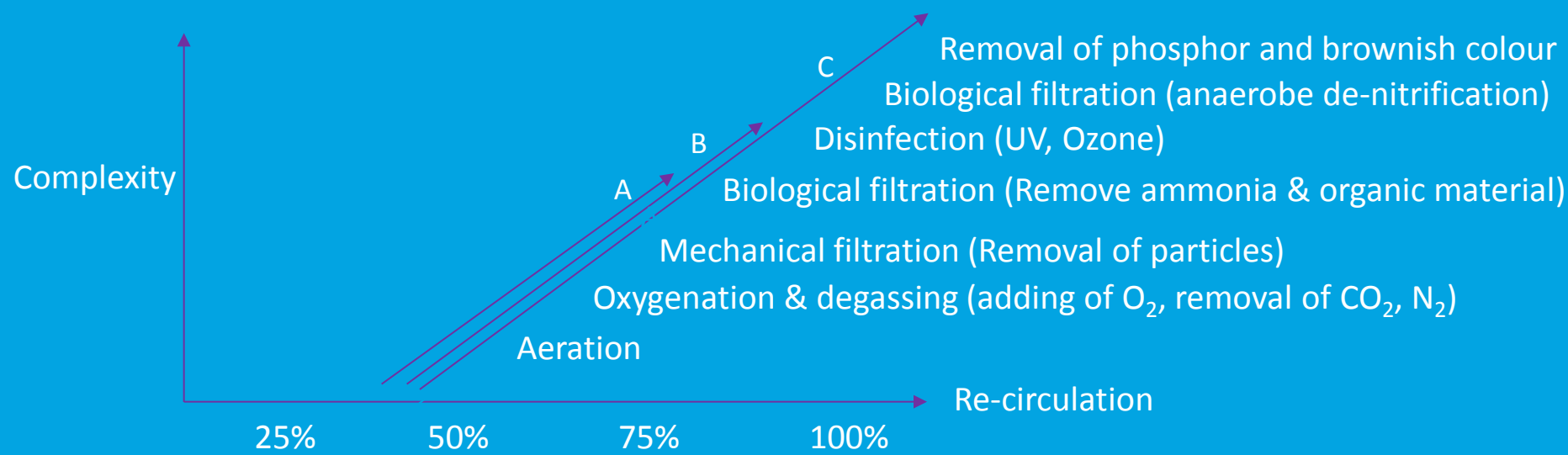
The water consumption per kg fish produced is thus depending on the farmers skill:  
If feed conversion ratio (FCR) is 1, the water exchange per kg fish produced will be 400  
If FCR = 0,9 consumption will be 360 litre per kg fish produced  
If FCR = 1,1 consumption will be 440 litre per kg fish produced

# Water flow through a Re-circulation system



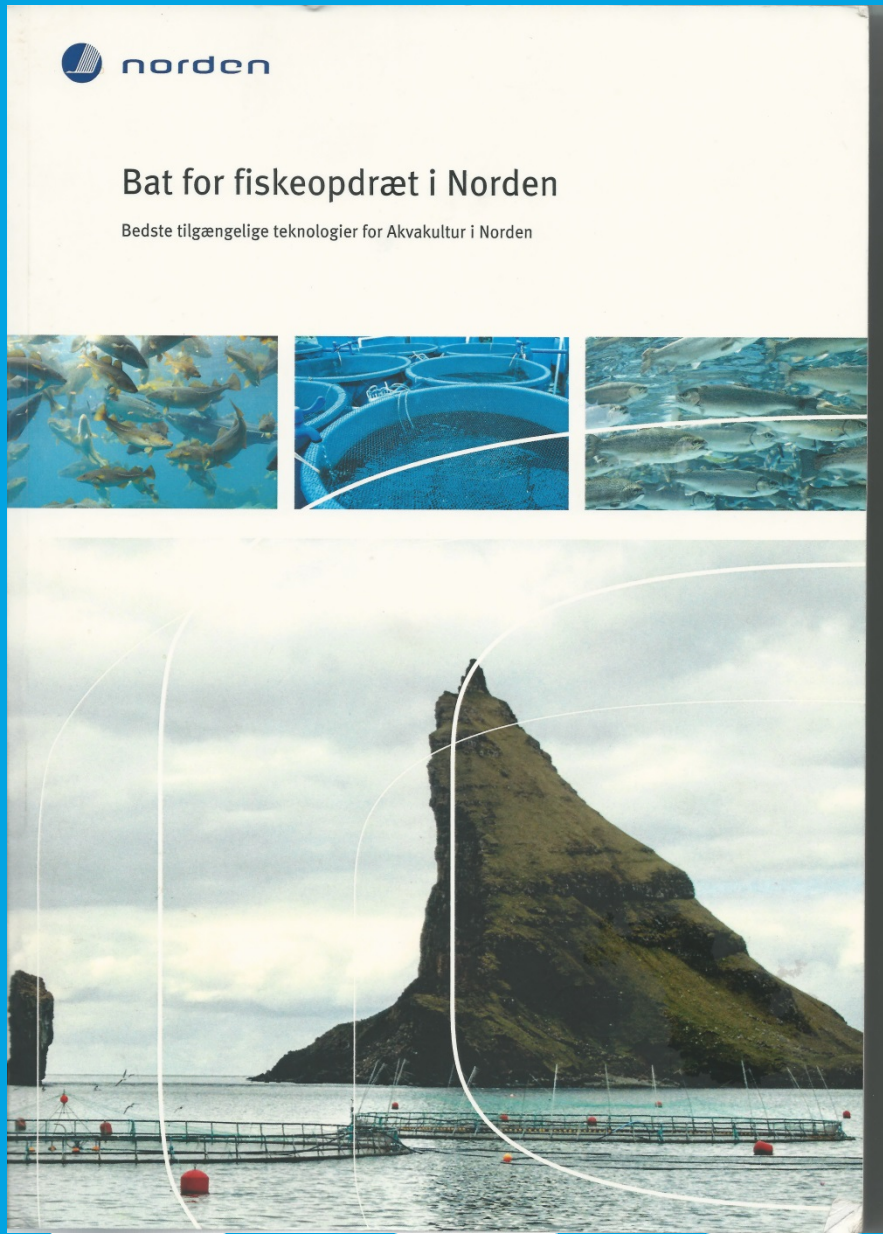
## General principle

**MODERATE RAS: Water consumption 400 – 700 litre new water/kg fish produced/year**

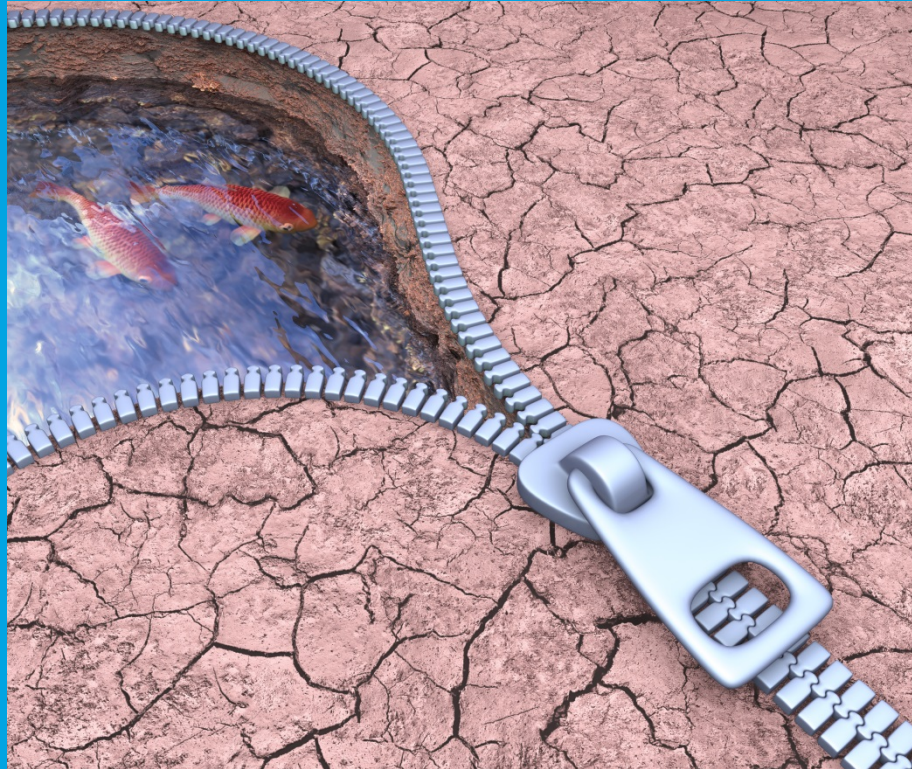


Flow through systems	40.000 - 50.000	Litre of new water/kg fish produced/year
Semi RAS (A)	2.000 - 5.000	Litre of new water/kg fish produced/year
<b>Moderate RAS (B)</b>	<b>400 - 700</b>	<b>Litre of new water/kg fish produced/year</b>
Intensive RAS (C)	50 – 400	Litre of new water/kg fish produced/year

# Best Available Technologies for Aquaculture in the Nordic Area



- TemaNord 2013:529
- Free download (406p/14Mb)
- [www.norden.org/en/publications/publikationer/2013-529](http://www.norden.org/en/publications/publikationer/2013-529)
- 40 pp summary in English
- Summary also available at Amazon: "Aquaculture in the Nordic countries and the BAT concept" (\$ 1.25).
- Printed book: 425 DKK (ISBN 978-92-893-2560-8)



## Unzip the potential..... Recirculated Aquaculture!

Farm fish everywhere with very little water and a very low environmental footprint