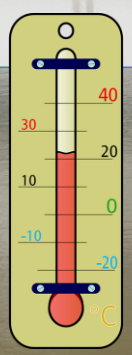
Training Course On Solar Powered Hatchery Operation

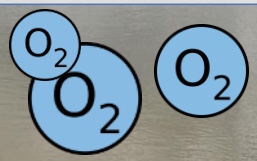
Organized from the Project "Ich liebe Fisch"
Bernd Ueberschär, GMA-Büsum

Fingerling production "in the wild"

Pros	Cons
• Natural feed available for larvae* • Few careness necessary • No grid power required • *special presentation	• Males and females mixed • Predation • Cannibalism • Feed competition • Water conditions not controlled (e.g. temperature, oxygen) • Number of fingerlings unknown • Mixed species (not just Chambo..)

Numbers of larvae & fingerlings

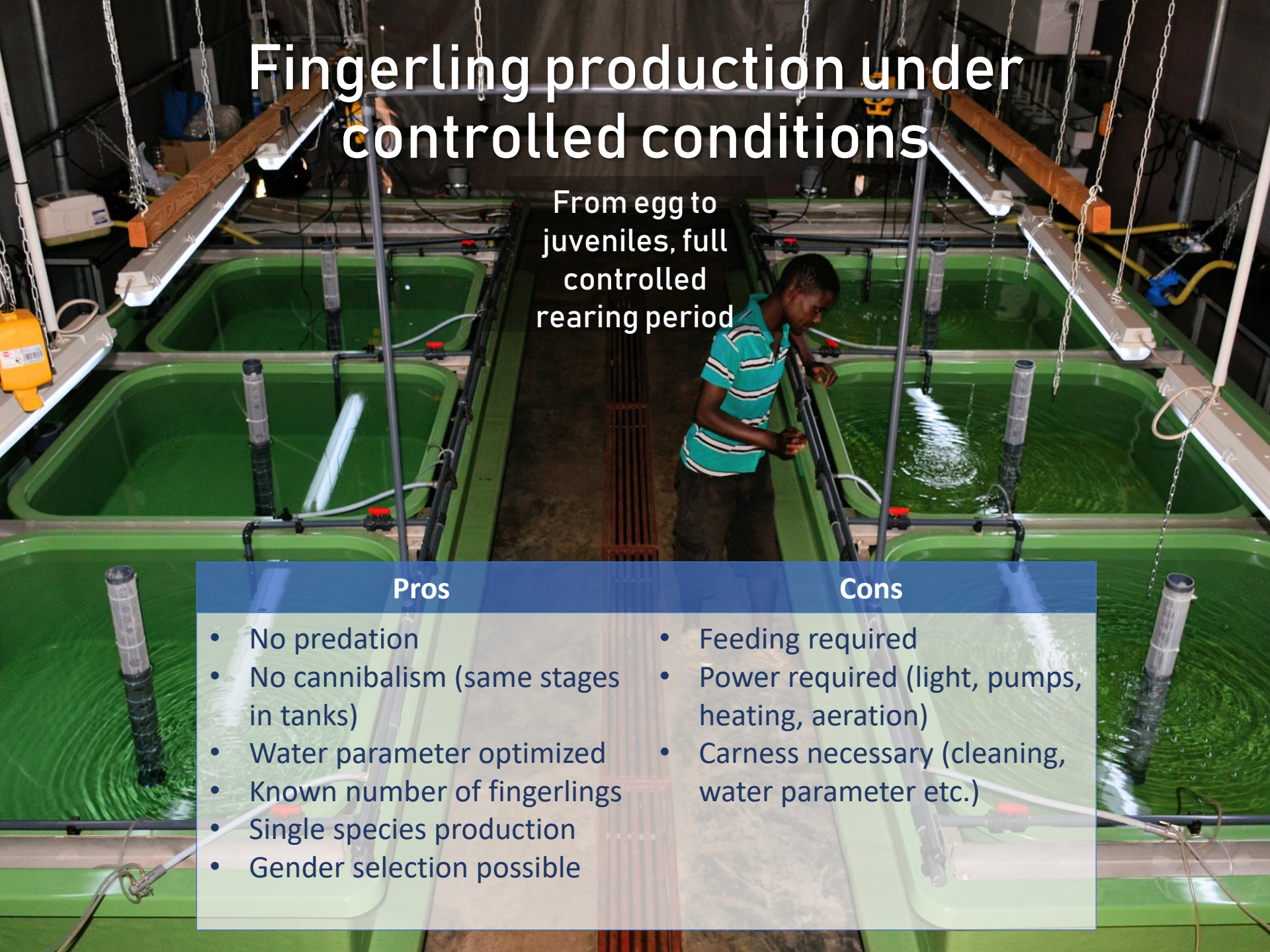




Sex of parents/off-springs

Fingerling production under controlled conditions

From egg to juveniles, full controlled rearing period



Pros	Cons
• No predation • No cannibalism (same stages in tanks) • Water parameter optimized • Known number of fingerlings • Single species production • Gender selection possible	• Feeding required • Power required (light, pumps, heating, aeration) • Carness necessary (cleaning, water parameter etc.)

Rationale and Background

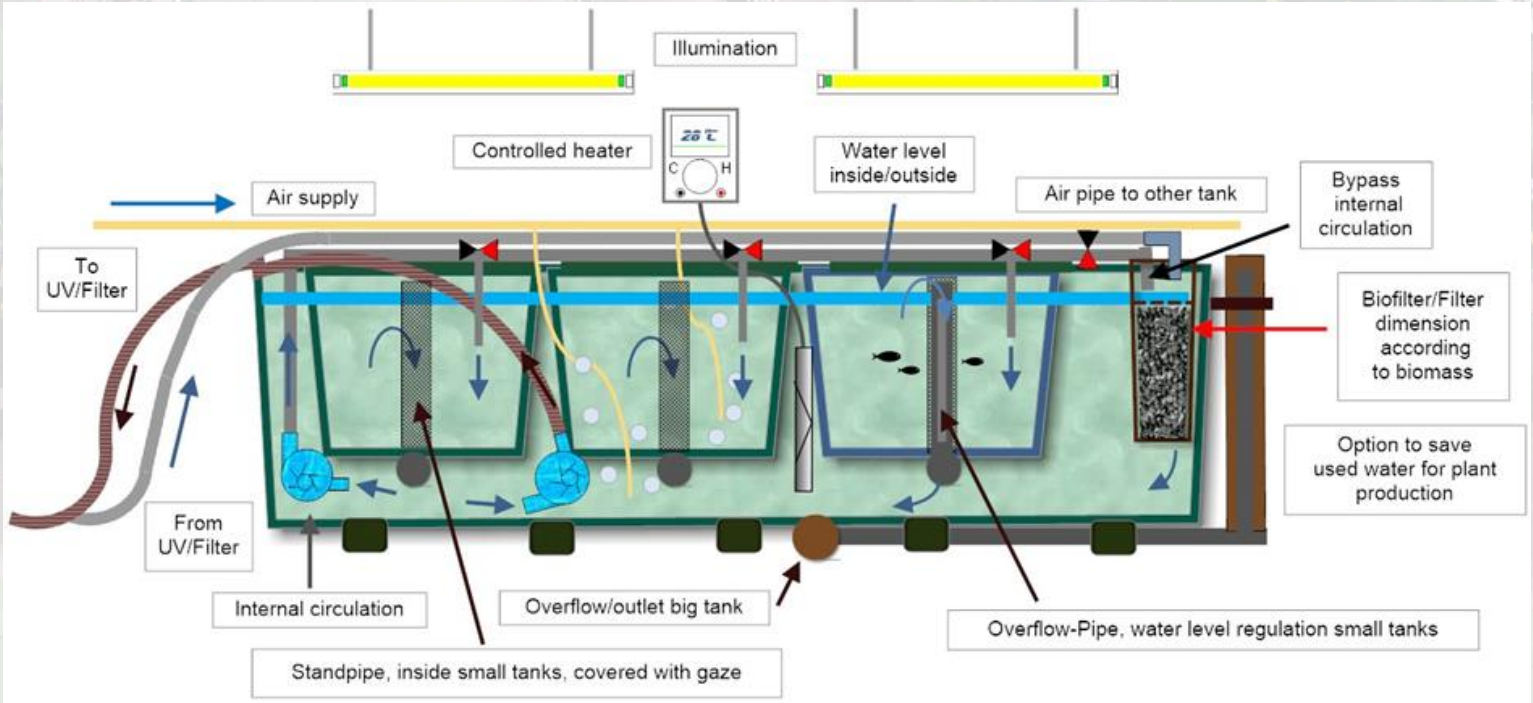
- Propagation and production of fingerlings in Malawi is usually conducted in ponds with all generations of tilapia and species.
- This implies, however, an unfavourable environment for fingerling production, including predation (predatory tadpoles from frogs are a huge problem in open ponds), cannibalism, feed competition and environmental impact.
- Consequently, the number of offsprings which can be expected from the farmer in a breeding season is unknown.

- Thus, one of the major goals of the project ¨Ich liebe Fisch "was to establish technologies which improve significantly the stable supply of viable fingerlings to farmers which want to grow fish for food and for the market.
- To achieve this goal, the project has provided a solar powered indoor hatchery which is designed to support intensive production of tilapia fingerlings, specifically from Chambo.

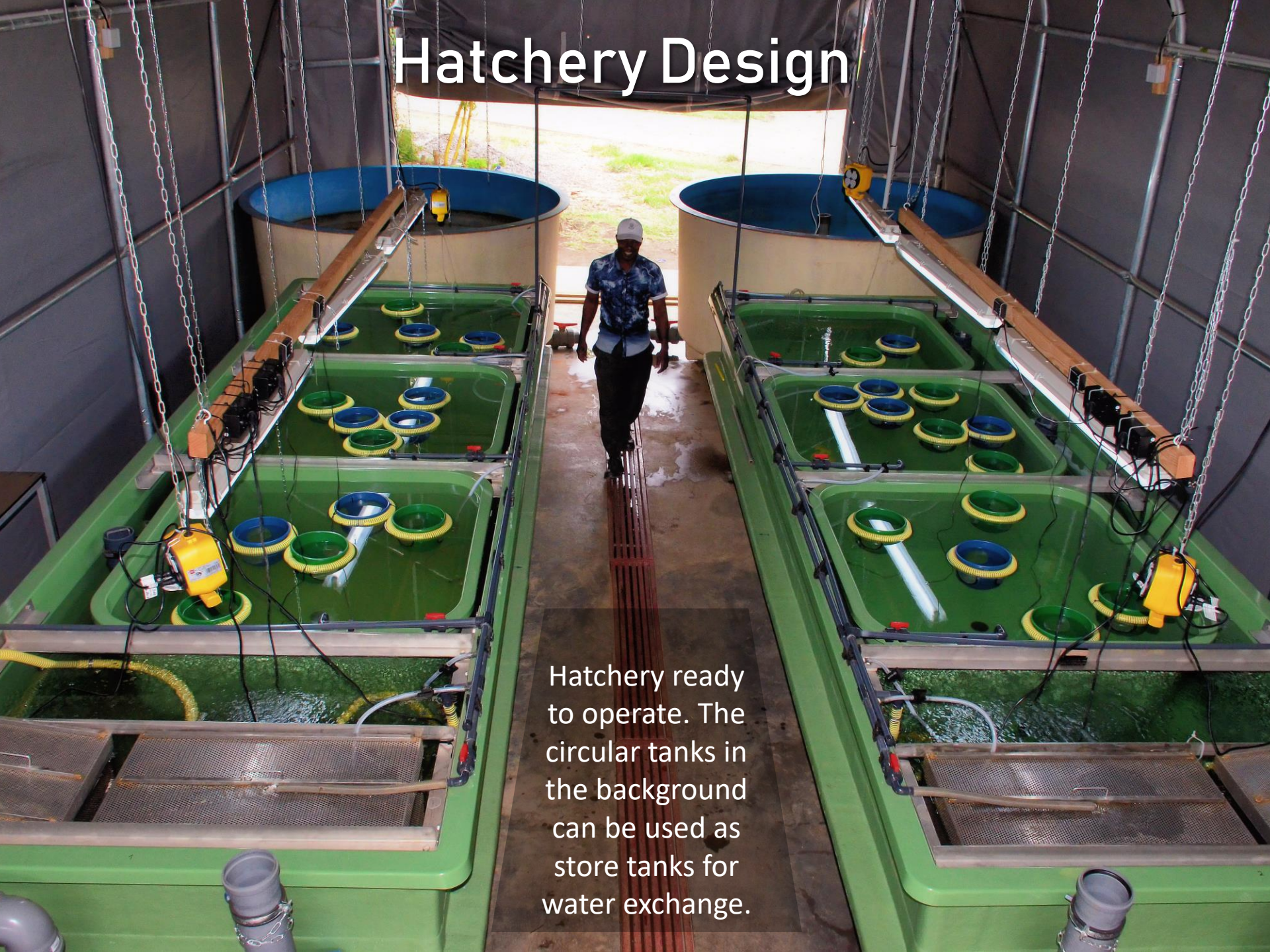
- Once the farm is under full operation, farmer can purchase viable Chambo fingerlings from the Bunda College (in the ideal case only males)

Hatchery Design

The design of the hatchery is based on a design which has proven it´s usefulness in fish larval rearing since more than 25 years. The design was adapted to the specific needs under the conditions in Malawian and the kind of species which will be reared in this facility. The main elements of the hatchery are two large fiberglass tanks with smaller tanks hanging inside of the big tanks



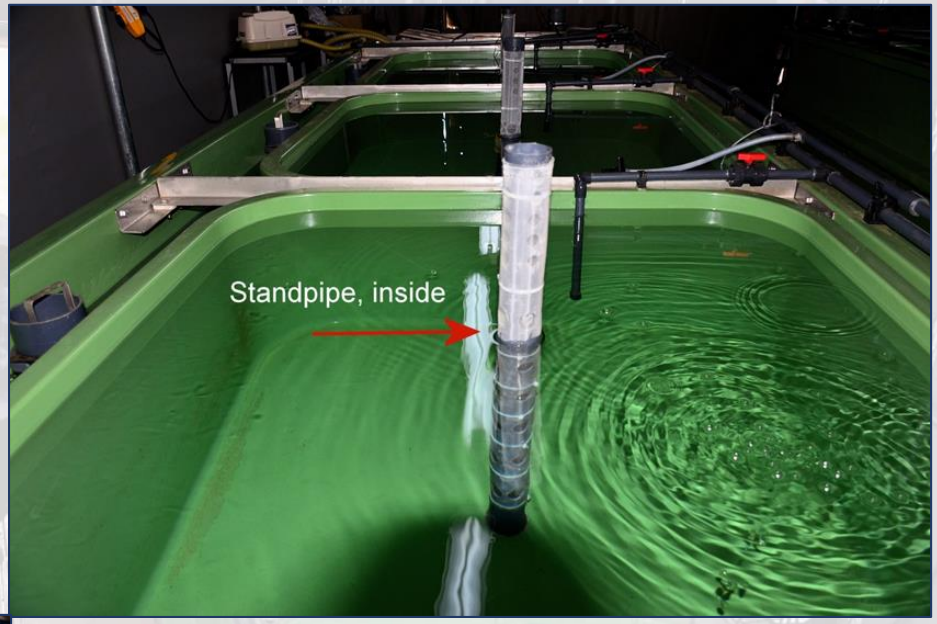
Hatchery Design

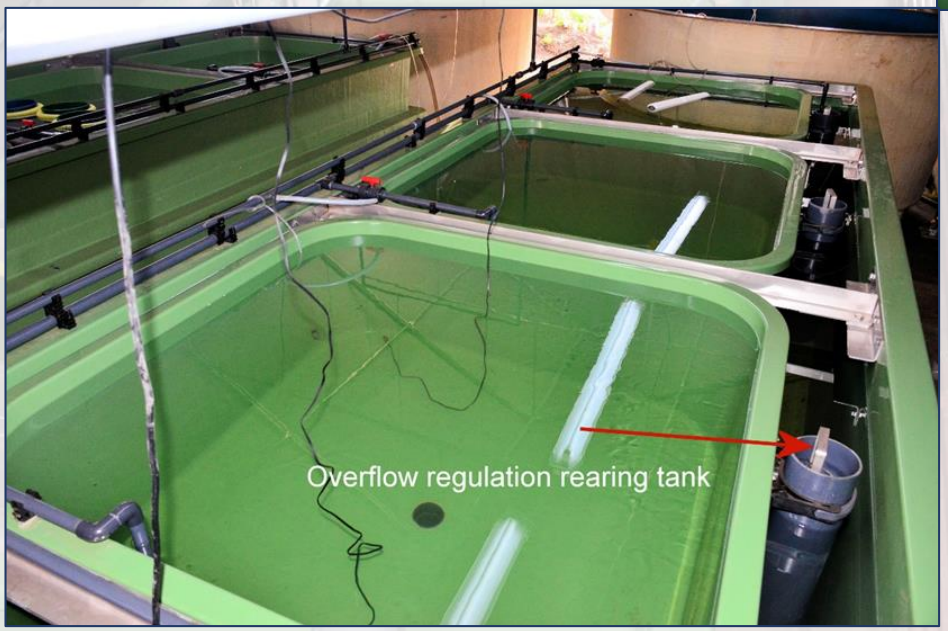


Hatchery ready to operate. The circular tanks in the background can be used as store tanks for water exchange.

Hatchery Operation

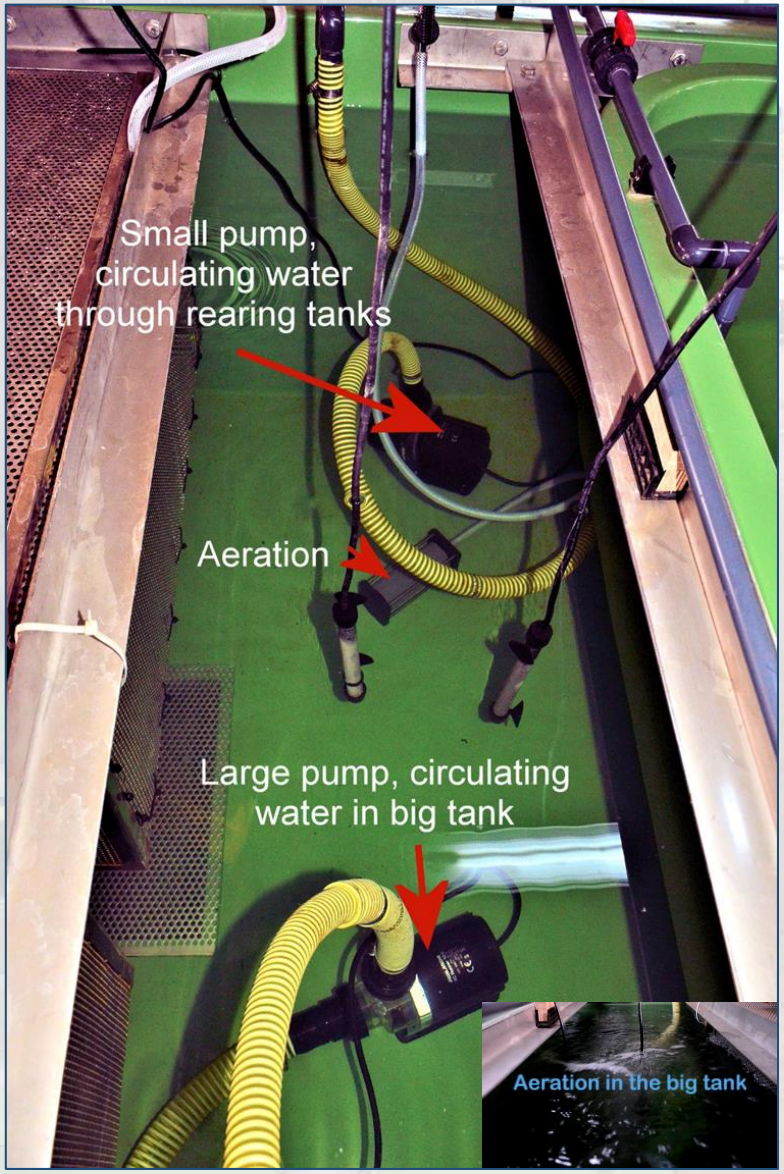
Standpipe inside of the rearing tank. Prevents larvae from getting out of the rearing tank. Need to be removed when filling the empty tanks (start of a rearing trial) until tanks are completely filled (please compare water level as shown in the picture with the water level in the big tanks).

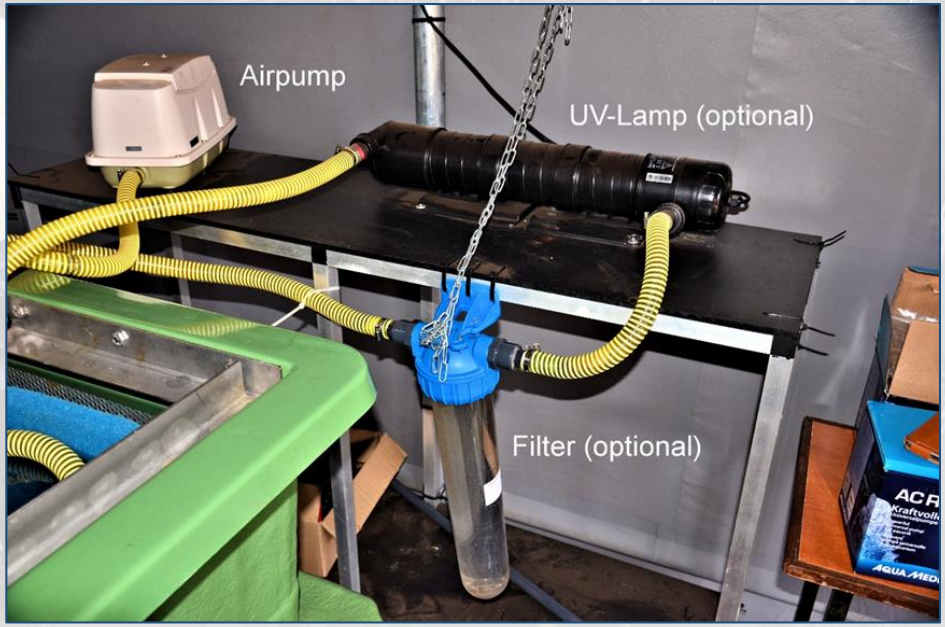




Picture shows the **location of the overflow pipe** which regulates the water level inside of the rearing tank and and relates to the water level outside in the big tanks. Needs to be removed when filling the empty tanks (start of a rearing trial) until tanks are completely filled (please compare water level as shown in the picture with the water level in the big tanks).

Hatchery Operation



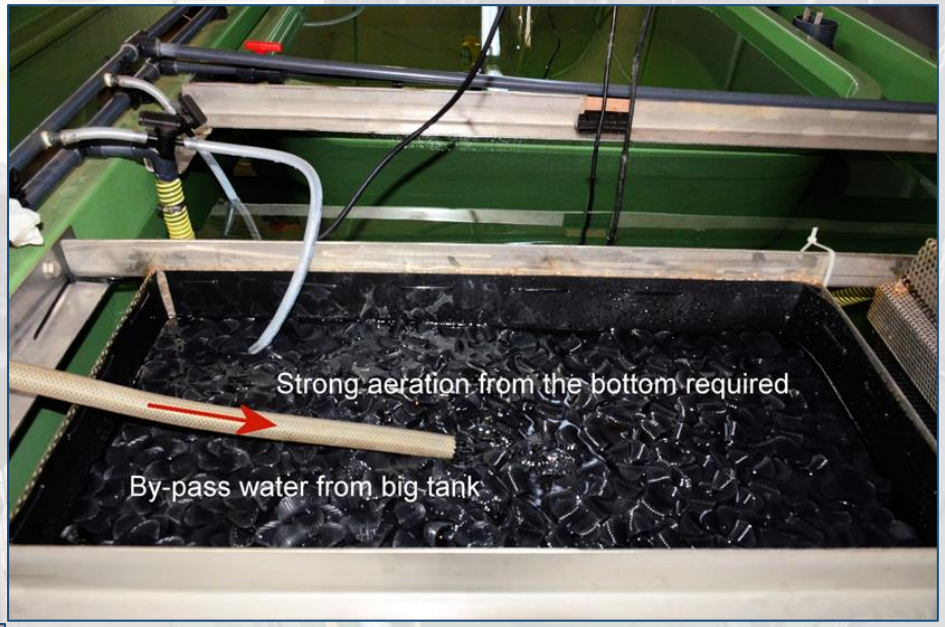


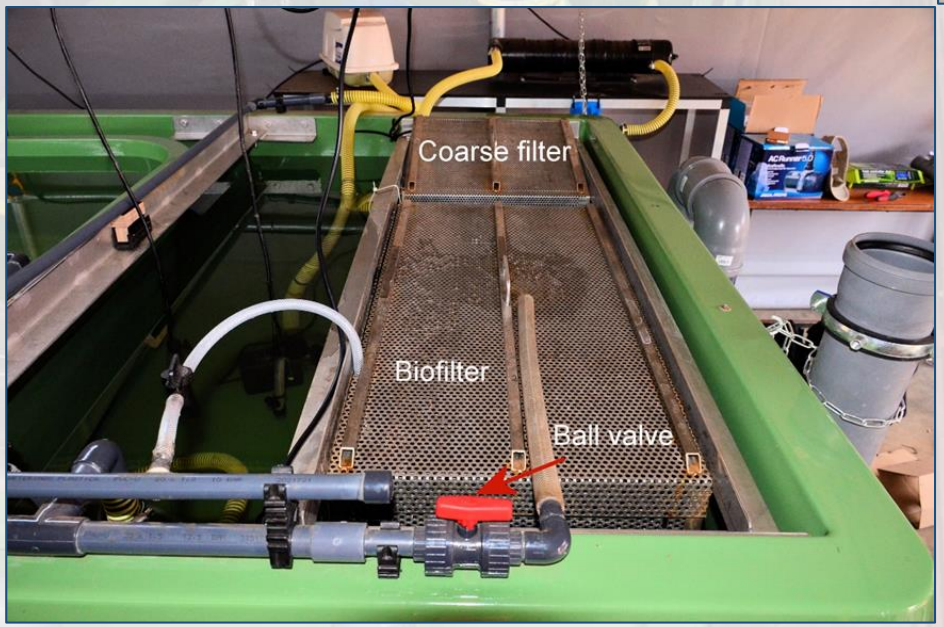
The figure depicts the **devices outside of the tank.** Left the **air pump** which provides aeration for both units, has always to run. In the middle, above, a **UV-Lamp** which can be used to reduce the bacterial load in the water. In the middle, below, a **water filter** which can be equipped with a filter cartouche to remove fine particles from the water.

The figure depicts the location of the pumps, the air diffusor and the heater. These devices are all installed in the large tank, between filter/biofilter box and first rearing tank. Access to these devices for maintenance work etc. is easy.

Hatchery Operation

The biofilter box, open. The biofilter is fed with water from the circulation to the rearing tanks from the big tank (by-pass water). Please note that the bacterial substrate in the biofilter does normally not need maintenance while running a trial but always a strong aeration from below.

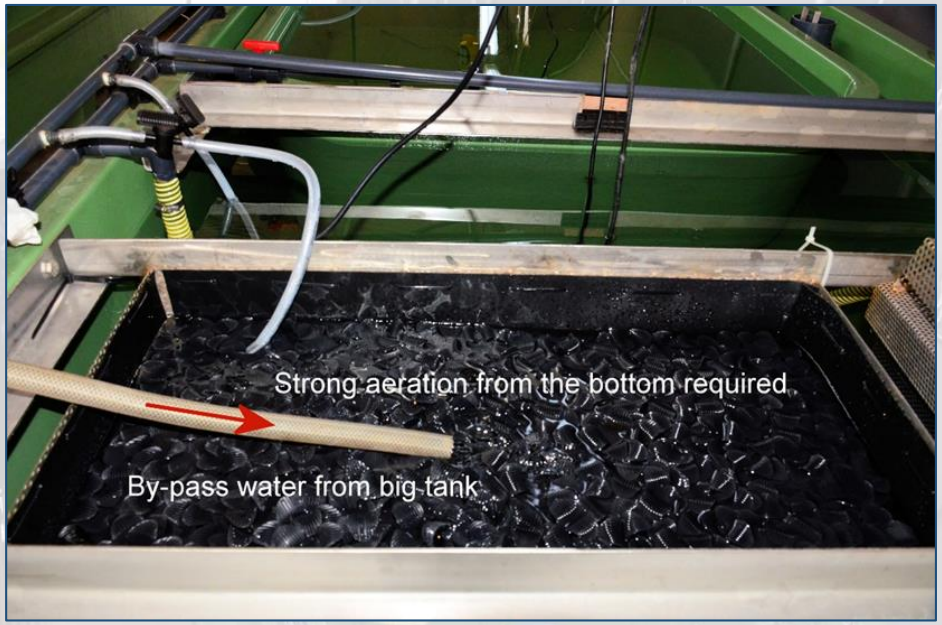


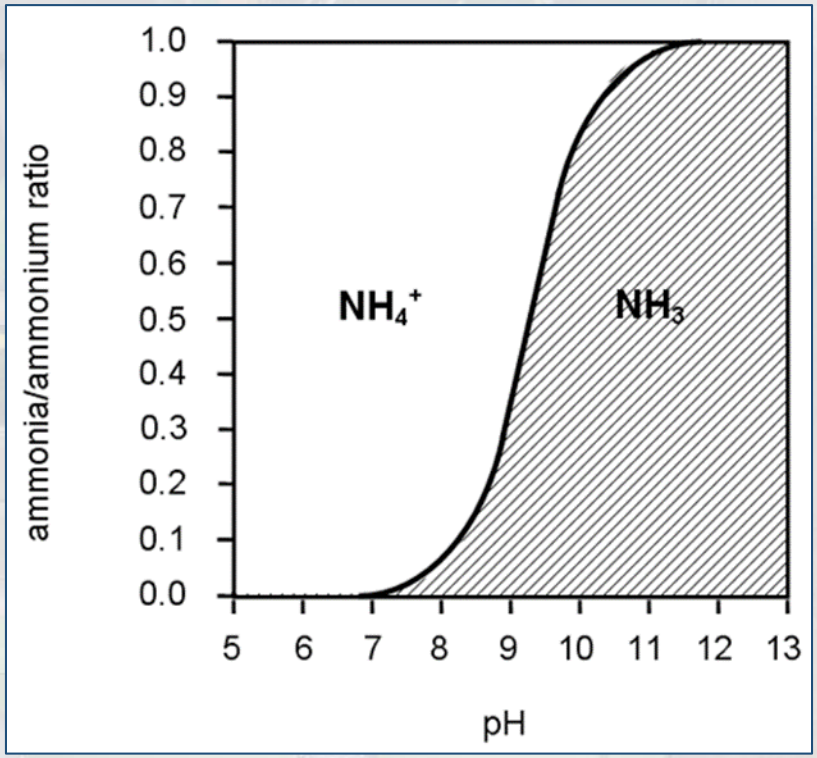


Biofilter/Filterboxes. The water to the biofilter is by-pass water from the circulation through the rearing tanks. The amount of water which passes through the biofilter can be controlled with a ball valve and needs to be adjusted according to the efficiency of the biofilter (refer to ammonium measurements).

Hatchery Operation

The biofilter box, open. In the biofilter, Ammonia and Ammonium are oxidized in two steps from different kind of bacteria (Nitrosomonas and Nitrobacter). Nitrification is the biological oxidation of ammonia or ammonium to nitrite followed by the oxidation of the nitrite to nitrate. The transformation of ammonia to nitrite is usually the rate limiting step of nitrification



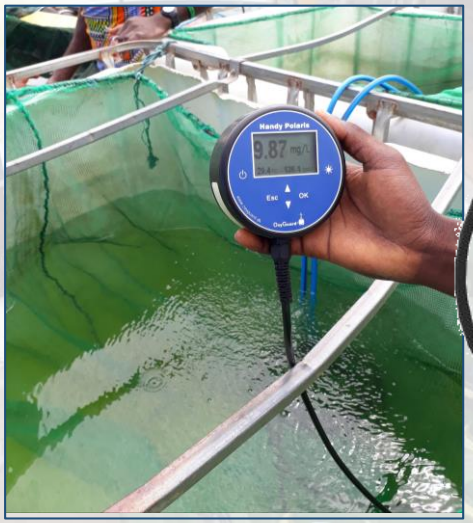


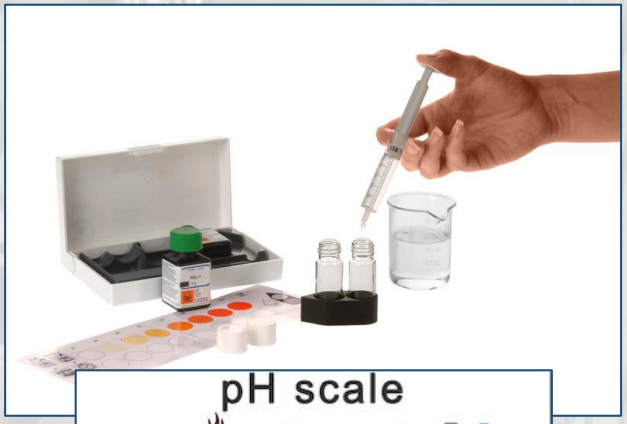
Ammonia and ammonium are different forms of nitrogen. The major factor that determines the proportion of ammonia to ammonium in water is the pH. The activity of the ammonia is also influenced by ionic strength and temperature. It is important to remember that un-ionized NH_3 can be harmful to aquatic organisms, while ionized ammonium is basically harmless. Ammonium even at high concentrations does not cause mortality in fish.

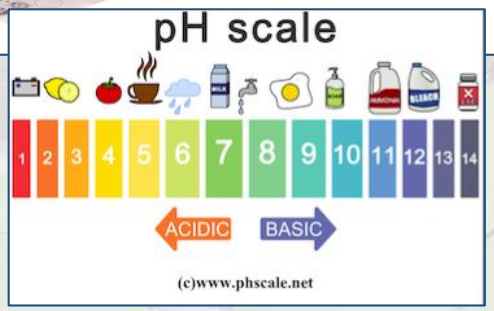
Hatchery Operation: Water parameter

Important water parameter

- Temperature
- Dissolved oxygen
- Salinity (marine water)
- pH (degree of acidity/alkalinity of the water)
- Ammonia
- Nitrite
- Nitrate
- Phosphate





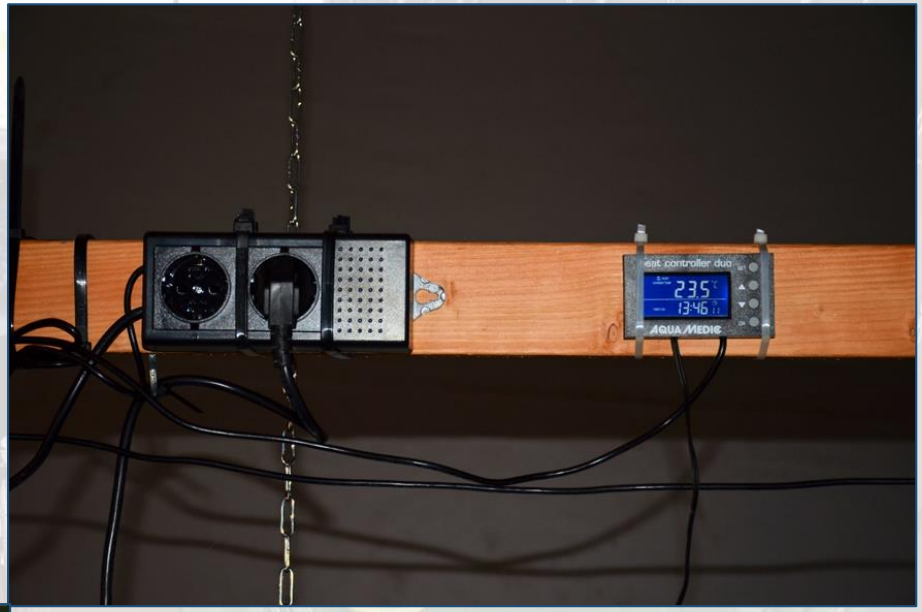


Water quality parameters that are commonly monitored in the aquaculture industry include temperature, dissolved oxygen, pH, alkalinity, hardness, ammonia, and nitrites. Depending on the culture system, carbon dioxide, chlorides, and salinity may also be monitored.

Tolerable/recommended values depend on the species and the life stage of the fish.

Hatchery Operation

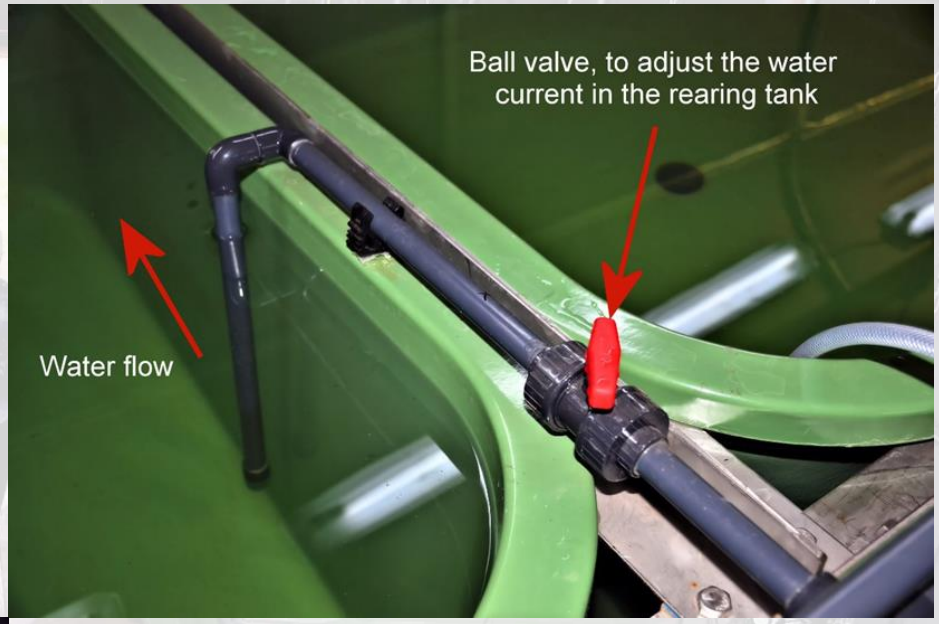
Control unit for the heater with power socket (left) and main temperature control unit (right). Make sure that the sensor of the control unit is deployed and free floating in one of the rearing tanks and well separated from the main heater.

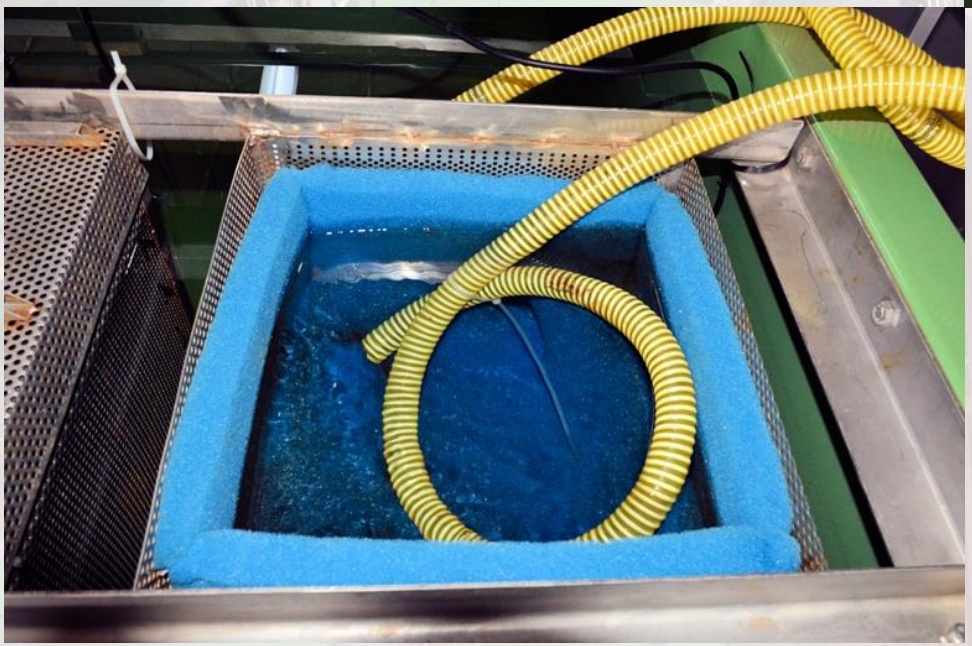


Heater in the big tank. Please make sure that they are always well submerged, free floating without touching other devices.

Hatchery Operation

The picture shows the water inlet pipe into the rearing tanks. The ball valve is needed to adjust the inflow of water from the big tank into the rearing tanks. With young larvae, the inflow needs to be rather gentle, with larger larvae the inflow shall be increasing. The vertical pipe has holes on one side (not visible here) and creates a circulating current inside of the rearing tank over the whole water column.





The water circulation out of the big tank, through filter and UV-Lamp, ends up in this **filter box** inside the big tank (box shown here with cover removed).

Hatchery Operation

The picture depicts the washing procedure of the blue foam. Press and rinse the foam carefully until the water in the box is becoming clean. There might be several re-fillings of the box necessary until all debris is removed from the foam.

The picture demonstrates the efficiency of the filter. This was the colour of the water after the first cleaning procedure. Continue until the water is almost clear.

McDonald Unit

By-Pass
from
Head-Tank

Mc Donald unit, installed in the hatchery. The system has a head and bottom tank, a tray for the jars and water is pumped continuously from the bottom tank to the head tank.

Pump to Head-Tank

A 300 Watt heater is installed in the bottom tank to achieve an appropriate temperature (optimal temperature is supposed to be 28°C for e.g. O. karongae). Flow through the jars can individually be adjusted.

McDonald Unit

By-Pass from Head-Tank

Zuger Glasses or Zuger jars are a type of equipment to breed fish eggs. Funnel shaped glasses contain the eggs while water is supplied from the bottom in an amount that the eggs are just kept in motion. The hatched fish larvae are usually collected with the spill over water from the top. Please note the high density of eggs which can be accommodated in the jars.

Newly hatched trout larvae, incubated in the Zuger Jars. Ready to be stocked in the rearing facility. Please note the huge yolk-sac, similar as in tilapia larvae.

McDonald Unit

By-Pass from Head-Tank

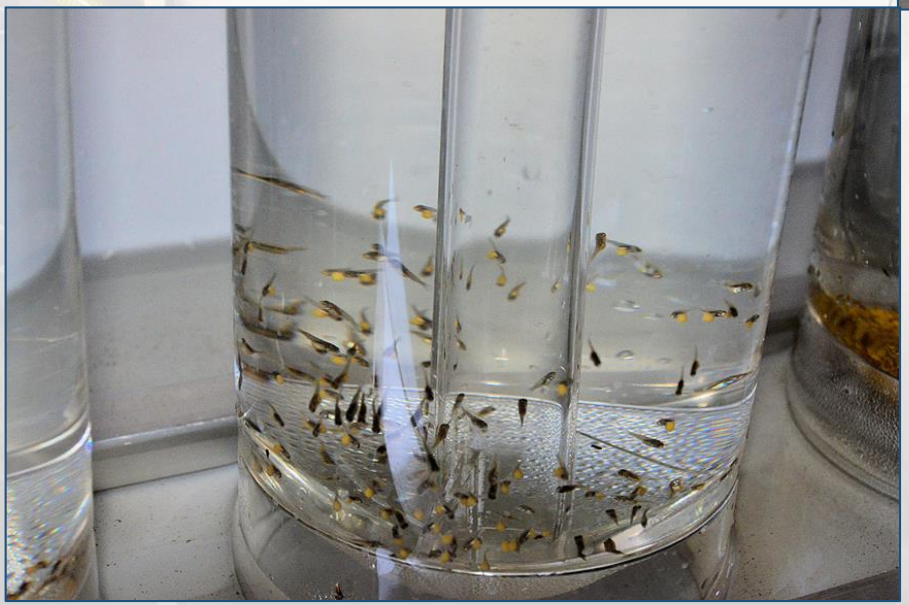
Box with fish and eggs on bottom. The eggs are retrieved out of the parent buccal cavity, collected on a piece of gauze and then put into clean water-filled beakers.

The collected eggs are then cleaned by sieving out all the debris using fine mesh mini-hand nets.

McDonald Unit

By-Pass from Head-Tank

McDonald jar with incubated eggs from Chambo. The eggs are incubated in separated jars according to their developmental stage. Unfertilized eggs (white colour) and debris can be carefully removed from the jars using e.g. a small net or tube.



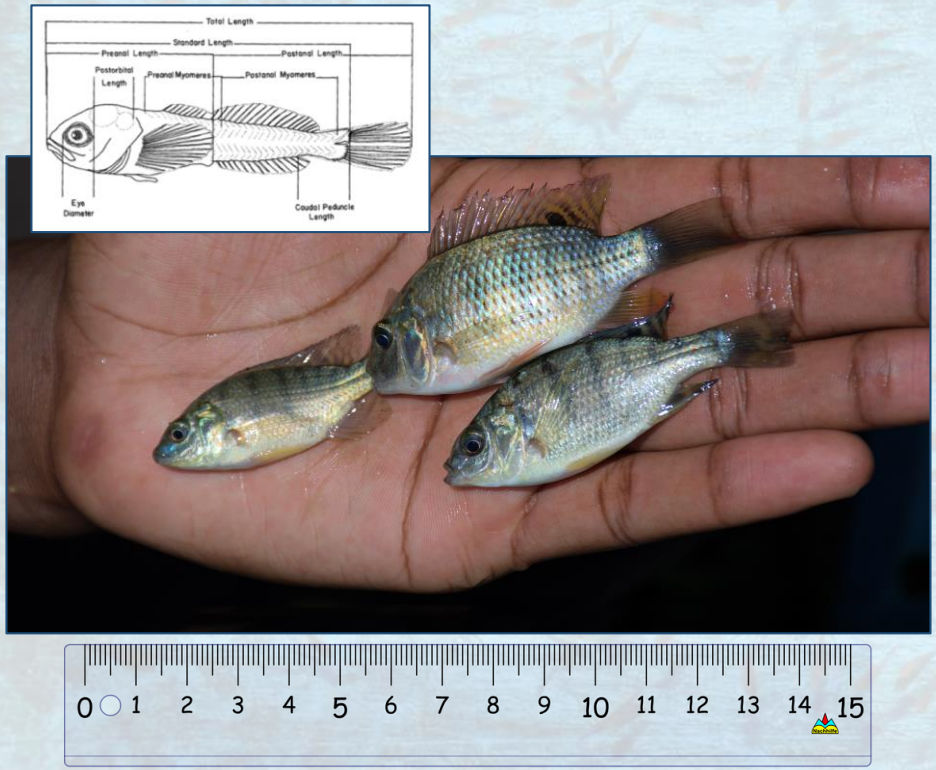
Newly hatched larvae, ready to be incubated into the rearing tanks. If all larvae in a jar are hatched at the same point in time, the jar can be carefully disassembled from the unit and drained directly into the designated rearing tank.

McDonald Unit, Home made…

Egg breeding unit, following the McDonald or Zuger jars principle. Home made at Bunda Campus with plastic bottles and some pipes (J. Valeta)

Success Factors in Larval Production

Success Factors which are relevant for growth performance are mainly the **feed quality/quantity** and **water parameter** (also true for ponds rearing)



Indicator: Monitoring various parameter in larval rearing are important to evaluate the success of a larval batch

Parameter:

- Mortality
- Growth rate (weight and larval length)
- Malformations

Post-Larvae transfer to Hapas

The capacity per rearing trial is about 50.000 tilapia larvae per unit. One trial in the indoor hatchery takes about 3 weeks, subsequently the post larvae are introduced into hapas in the ponds of the farm where they are able to adapt to pond conditions in a protected environment, and are raised until they have reached the right size to be disseminated to the farmer (about 5-10 g).

Title/URL	QR-Code
Slow moving water body for late larvae and juveniles www.youtube.com/watch?v=EW1nZyV_PzI	
Fast moving water body for late larvae and juveniles www.youtube.com/watch?v=UaAA9MVk0D0	
Water flow in McDonald unit www.youtube.com/watch?v=goHGbt6cGzs	
Bubbles for newly hatched and young larvae www.youtube.com/watch?v=HWNxhDRVkRw	
Aeration in the big tank www.youtube.com/watch?v=F2js5YgMV8U	

Conclusions

- **Intensive indoor rearing of tilapia larvae is the next level of fingerling production** (Hatchery operation 2.0…) and allows the full control over all factors which promote e.g. the growth rate and output in numbers.

- **However this approach requires set-up of special technology and, under conditions in Malawi**, also a grid-independent supply of power to be able to run the hatchery devices without a break.

- **Feed is required until the advanced larvae are introduced into ponds**, and even then, given with the high numbers produced, further add-on feeding in hapas is required.

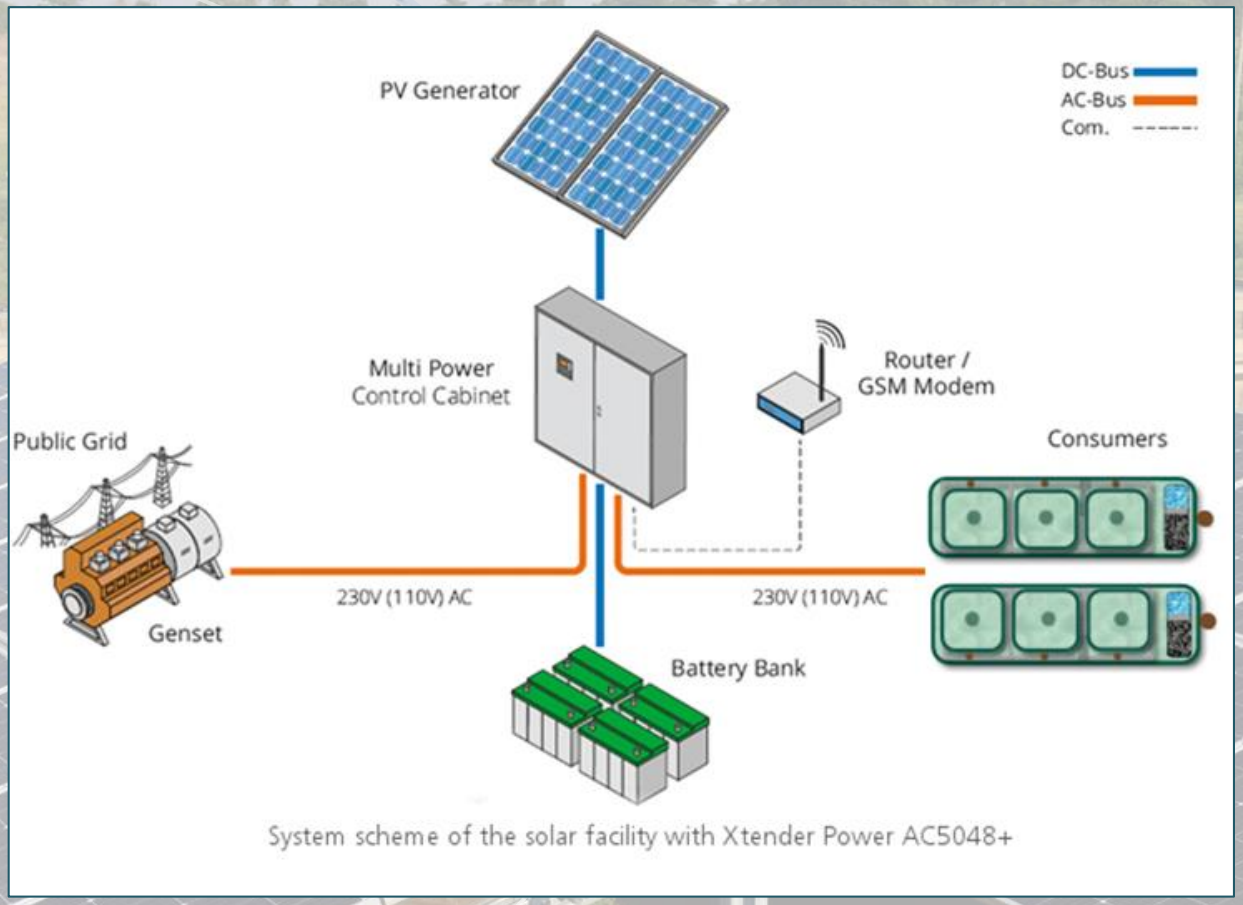
- **Part of the technological, strategical and operational background can nevertheless be "translated" into more simple approaches** which may already facilitate to increase the output of more fingerlings on the farmers level.


Ich liebe Fisch
www.fish-for-life.org
Solar Power
Facility

Why solar power for the hatchery?

- Grid power in Malawi fails frequently.
- Since such a hatchery set-up needs constant power supply in order to run pumps, aeration, illumination and heaters without a break, a solar power unit was attached to the hatchery.
- Gensets as a continues provider for power are not an option, since fuel and gasoline are very expensive in Malawi. The solar power unit was designed as an island solution and provides sufficient power for the equipment in the hatchery 24h/7days a week.
- The solar facility provides about 1.7kW in the night which is sufficient to run the most important equipment without a break.
- The solar power can automatically switch to grid power when available.
- A diesel genset which automatically starts is being installed as an emergency back-up when both other sources for electricity fail.

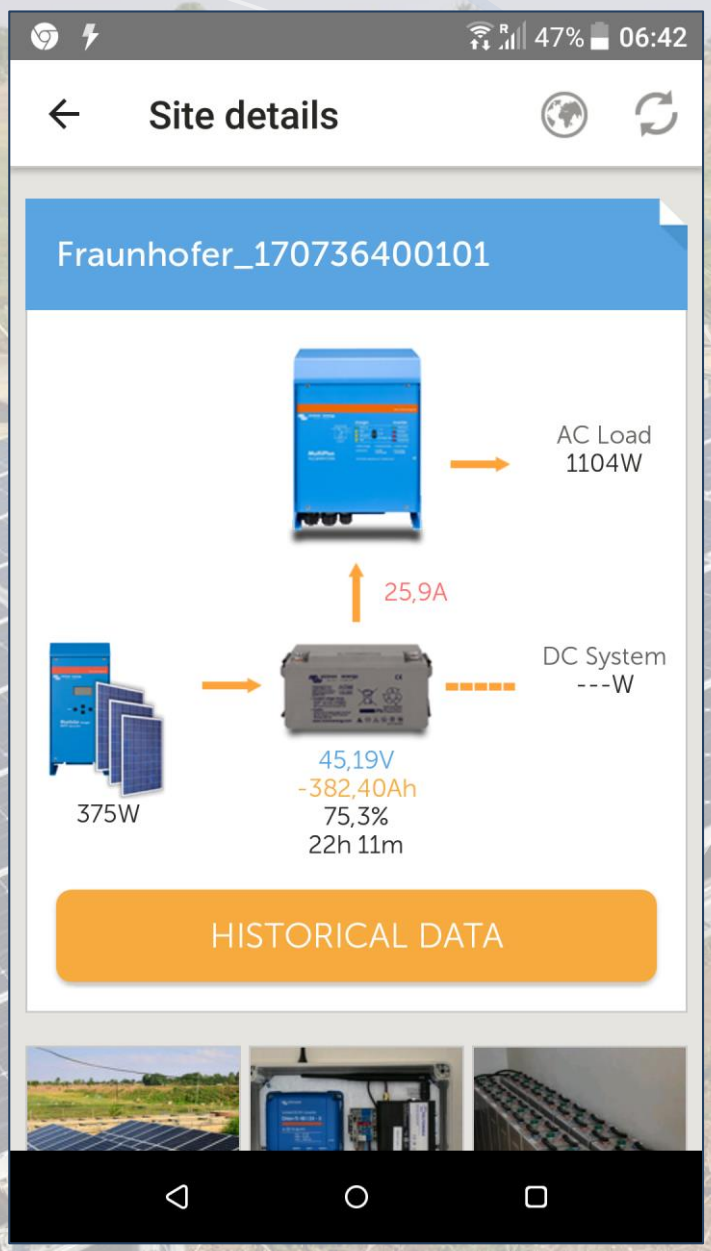
Schematic sketch of the solar power system



System scheme of the solar facility with Xtender Power AC5048+

Schematic sketch of the solar power facility which provides permanent electricity for the hatchery operation. The system has 36 solar panels, each providing about 300 Watt. The battery block has 24 batteries with in total 48 Volt and 1270 Ah per battery. The facility is designed as an island solution; however, grid power can be used when available to increase the batteries life time. Additionally, a genset is attached as emergency back-up. The system can be remote-controlled through a GPRS modem.

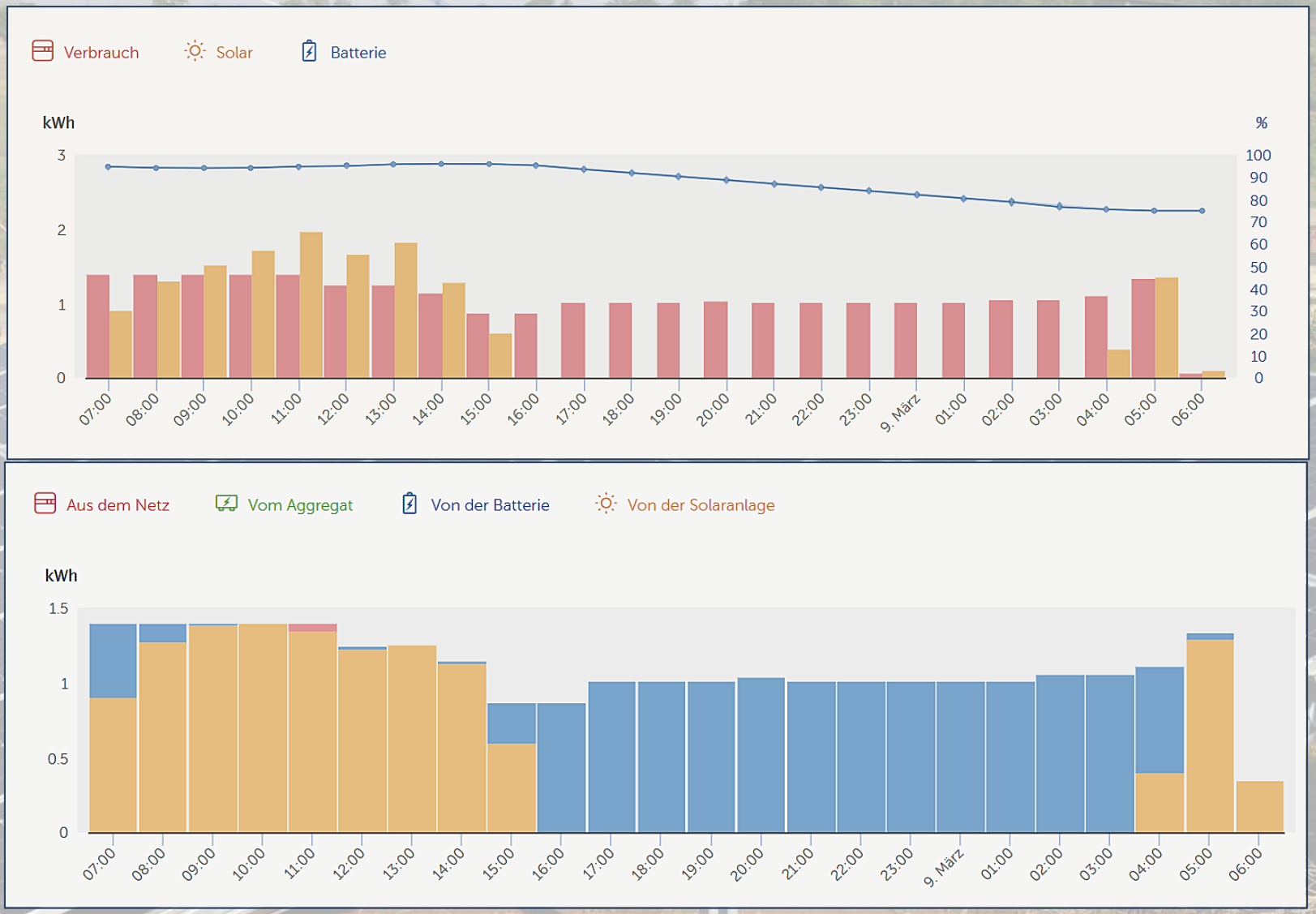
Remote Control of the solar power system



With the installed modem, the system can be surveyed from any place where you have an Internet connection, even from the smartphone.

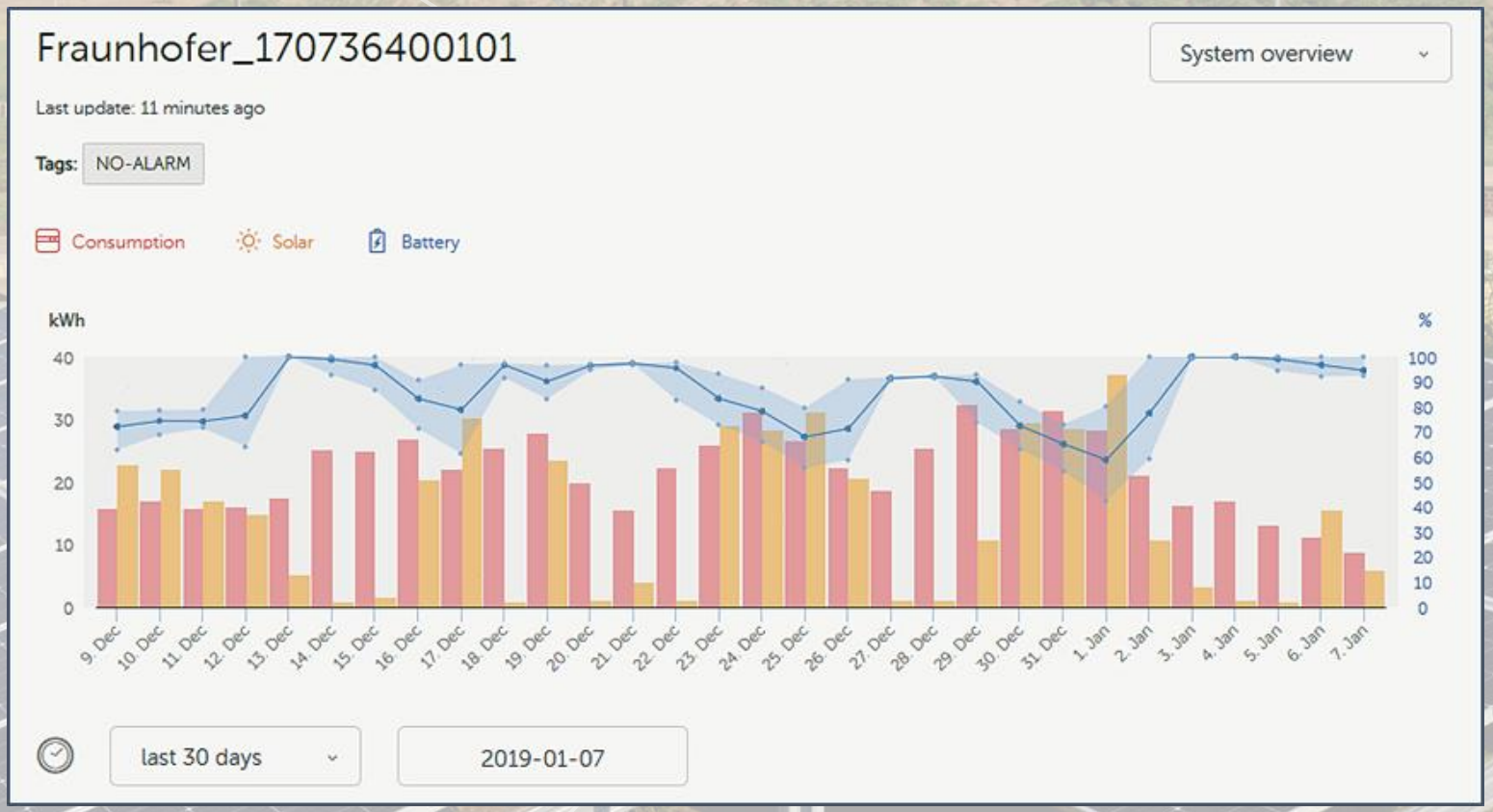
This allows to take immediate actions, once the system e.g. runs into low power or to fix any other issues.

Power producton and consumption



Typical profile of power consumption, solar power and battery charge over 24 hours. No national grid available.

Power producton and consumption



Typical profile of power consumption, solar power and battery charge over 30 days. It can be seen, that the discharge status of the batteries sometimes exceeded the desired range of 30%.

Solar power needs management!

Device	Number used in the hatchery	Power consumption (Watt/unit)	Total Consumption Watt
Pump AC Runner 5.0	3	44	132
Pump AC Runner 12.0	2	92	184
Aeration	1	130	130
Illumination	6	16	96
Heater	7	300	2100
Summary			2642

The table lists the devices which are operated in the hatchery (above) and in the McDonald unit (below) and their significance for the hatchery operation. Mainly the heaters are optional and since they are the largest consumers of electricity when running, these are the devices which need some management

Device	Significance	Comments
Hatchery		
Pump from big tank into small tanks	High, MUST run	Shall not stop under any circumstances
Pump circulation big tank, filter and biofilter	High, MUST run	Shall not stop under any circumstances
Aeration	High, MUST run	Shall not stop under any circumstances
Heater 1	Shall run	but can be unplugged at critical battery status
Heater 2	Optional	must not run in the night, shall be unplugged when battery status is critical
Illumination	Shall run	Illumination is automatically switched off in the night, thus not critical during night time operation.
McDonald Hatchery, egg incubation		
Pump	High, MUST run	If this pump stops, eggs/larvae in the jars will die
Heater	Shall run	This heater has higher priority as the heater in the hatchery tanks but can be unplugged at critical battery status.

Thank you for your Attention!

The full manual on hatchery operation can be downloaded from the "Ich liebe Fisch "website

www.fish-for-life.org

Bernd Ueberschär, GMA-Büsum

e-mail: ueberschaer@gma-buesum.de