INFORMATION
SEAWATER CUBE
Local is the new organic
Consumer food preferences are changing to regional and local products. This is true not only for agricultural products but also for marine foods. The EU household expenditure for fishery and aquaculture products increased to €54.8 billion in 2016. The rising demand leads to the decrease of the EU self-sufficiency resulting in the increasing need for the import of fish. Since 1990 the development of fishing stagnates due to limited resources and worldwide overfishing, aquaculture experiences a tremendous growth. In 2016 the share of aquaculture equalled the share of fishery. Thus, every second fish we eat derives from aquaculture. The demand for animal protein is increasing parallel to the world’s population. Therefore, future growth of aquaculture is forecast to 7% annually by the FAO, the Food and Agriculture Organization of the United Nations. In addition to the boost of aquaculture the price per kilogramme of fish increased by 25% for sea bass since 2005 (EUFOMA, the European Market Observatory for Fisheries and Aquaculture Products).

Not every type of aquaculture is sustainable
Nowadays there are several solutions for cultivating seafish but there is only one system to produce seafish on land: recirculating aquaculture systems (RAS). Those systems are highly technical and can operate apart from the sea with very low water requirement. However, actual state of the art RAS suffer from several drawbacks and are not commonly used for fish cultivation. They are not economic because of high engineering, high investment, and high operating costs for skilled staff to run the system. Also, the installations of those systems are in general single projects under unproven conditions (e.g. size of the farm, compilation of subcontractors) and very risky. The SEAWATER Cube is the first small-scale recirculating aquaculture system that can be operated with economic and ecological benefits. The system was designed to satisfy the rising demand for fish and to push forward the rapid expansion of aquaculture. The cube can produce an output of around 7 tonnes fish per year on a ground area of only 100 m². Due to this compact size, we firstly realize the regional and decentralized supply with premium animal protein, polyunsaturated fatty acids, vitamins and minerals. The consumer ultimately benefits from the freshness and high quality of the product with local origin. Further advantages are that natural ecosystems are protected, and the European economic power is strengthened by increasing the self-sufficiency with fish. To summarize there is an outstanding potential in the economic and ecological sense and SEAWATER Cubes GmbH is ready to exploit this potential.
THE SEAWATER CUBE

The SEAWATER Cube is the first series ready, fully-automated and environmentally friendly farm for reproducible fish growth.

The SEAWATER Cube is the economic solution for the unprecedented regional production of seawater fish especially in non-seaside regions. Our patented innovation is the first small scale and ready-to-use seawater aquaculture system, housed in three shipping containers. It enables the sustainable production of nutritious and savoury, marine fish. Core of the invention is an intelligent software solution allowing for the self-organising fish production with 100% process reliability. Controls are fully automated and developed for the auto-regulated adjustment of the most beneficial and species-appropriate growth conditions for the fish. Sensors monitor different parameters in real-time and adjust the addition of animal feed and adjuvants. Moreover, the clarity of the water is ensured by our sophisticated filter technology. Further, the software allows for predictive maintenance in order to prevent damages before they occur – without the need of the operator to intervene actively. Finally, every cube communicates with our headquarters through a telecontrol system. This offers the opportunity to support future customers within the production process and to improve our product constantly by collecting and evaluating increasingly larger data sets.

The Cube gives you the opportunity to expand your business portfolio and to generate additional revenue. For the installation, you only need around 100 m² of ground space and thus you can perfectly use existing and underused areas. The cube can be fished continuously over the whole year. Therefore, you will be able to plan your sales. In addition, our closed circulatory system is independent of external environmental impacts which reduces the investment risk significantly.

Our vision is to establish a new business model for the local and sustainable fish production addressing the rising customer demand for regional products.
THE SEAWATER CUBE

The aquaculture industry has so far been characterized by large-volume individual plants. These are designed and built on a one-time basis, resulting in a high investment and planning effort as well as a high susceptibility to errors. The implementation of such large-scale projects involves many specialized companies. The view for the successful combination of different departments and components is often lost here. This results in aquaculture facilities that are only partially executable, often require improvements and in which the unexperienced operator is left alone with the technology and has no skilled contact person.

Initiated by research in the laboratory of the University of Applied Sciences in Saarbrücken (htw saar) and requests of potential customers, mostly farmers, we developed the idea of the SEAWATER Cube – a ready-to-use closed aquaculture system for marine fish based on the already developed RAS technology. This idea was first formulated in 2016. After lab scale validation of the technology, we successfully sought capital in 2017 which we acquired by the EXIST-Transfer of Research. The EXIST funding of the German government enables the demonstration of the SEAWATER Cube prototype in relevant. The prototype is successfully running since October 2018.

With the SEAWATER Cube we offer for the first time hardware, software and support from a single source. The focus of the technology lies on standardization and user-friendliness, which are achieved by the container structure and the comprehensive automation solution. We also offer an after-sales concept for technical maintenance and we support our customers with the delivery of seedlings and feeding. If it is necessary, we also provide marketing and sales concepts.
In the SEAWATER circuit, which results from many years of intensive research, two main objectives are pursued: continuous production and the provision of ocean-quality water. Continuous production is achieved through the ‘three-cohort model’. The production tank is subdivided into three basin areas containing different age groups (the cohorts). The areas are separated by net barriers. Sea bass and gilthead Seabream have a market size of around 300 to 400 grams and reach it after eight to twelve months. This results in a stocking plan in which the fishes spend about four months in each cohort. The third cohort containing market-sized fish is harvested continuously for four months. Cohorts one and two are then moved further and the first area of the tank is re-occupied. The ocean quality of the water is ensured by an elaborate water treatment system. After the production tank, the water passes through several mechanical and biological filter stages in order to remove all particulate and dissolved residues from the process water, and to provide the fish with an optimum habitat.

Currently the technology is adapted for the following fish species:

- Sea bass
  Dicentrarchus labrax

- Gilthead seabream
  Sparus aurata

- Yellowtail Kingfish
  Seriola Lalandi

- Black Tiger Prawn
  Penaeus monodon

- Red Snapper
  Lutjanus campechanus

- Malabar Grouper
  Epinephelus itajara

Further adjustment of the cube & the technology is planned for the following fish species:
SEAWATER CIRCUIT

PARAMETERS OF THE CUBE & THE PRODUCTION

Storage space: 100 m²
Water volume of basin/production: 55 m³
Water volume of the filters: 15 m³
Overall water volume: 70 m³
Water exchange: approx. 500 l / day
Water exchange rate: < 1 % of the production volume
Waste water disposal: via municipal sewage network
Installed power: 7.5 kW
Power consumption: ca. 50,000 kWh / year

Maximum stocking density: 65 kg biomass / m³ production volume
Basin sections: 3
Growth period per cohort: approx. 4 months
Market maturity (350 g - 400 g): after approx. 10-12 months
Number of fishes: 21,000 (7,000 per basin section)
Maximum feed quantity: approx. 30 kg / day; approx. 10 t / year
Production quantity per year: approx. 7.35 t raw fish

1) Basin with 3 sections
2) Drum filter
3) Sedimentation
4) Circulation pump
5) Biofilter
6) Compressor
7) Ozone generator
8) Flotation
9) CO2 Desorption
10) Denitrification
LOCATION CONDITIONS

In principle, the Cube is suitable for outdoor installation. However, there are a few aspects to consider here.

For the installation of the SEAWATER Cube at your location you need:

- Fresh water connection (similar to normal house connection: approx. 2.5 bar, 2 m³/h)
- Connection to municipal waste water or comparable discharge
- Power connection (three-phase current, 400 V, 32 A)
- Load-bearing, level subfloor (load 1t/m², according to structural analysis)
- Internet connection (DSL), if not available replacement with UMTS module

Please also check BEFORE placing your order:

- Whether your road can be driven by a truck. The dimensions of a 40 tonne truck are for example L x W x H 18 m x 2.5 m x 4 m.
- Whether there is a final, loadable access, holding and unloading possibility for the large truck. This means sufficient space depending on the Colli size/size of the general cargo! General formula for this: 2.5 m truck width plus length of the largest colli plus 1 m manoeuvring width) - in other words approx. 5 - 8 metres.
INDUSTRY

The SEAWATER Cube is beyond state of the art because there is no economic, fully-automated and small-scale solution for the cultivation of seafish on land. However, alternatives to fishery are more than necessary because 33% of the commercially used fish stock is overfished and 60% can be maximally sustainably fished. Aquaculture appears to be the most feasible solution apart from fishery.

There are three categories of aquaculture: **extensive** (Adoption of traditional techniques of aquaculture e.g. dependence on natural productivity and little control over the stocks; e.g. pond culture); **semi-intensive** (Adoption of mid-level technology, partial dependence on natural productivity, fertilization, supplementary feeding, with stock manipulation, medium level inputs and medium rate of production; e.g. net-pen, raceway); **intensive** (Adoption of the full complement of culture techniques including scientific tank design, fertilization, supplemental feeding or only feeding without fertilization, full measure of stock manipulation, disease control, scientific harvesting, high level inputs and high rate of production; e.g. RAS). **Open systems** – pond, net-pen, and raceway – are installed in or close to the sea. Space and access to water are prerequisites for building new open systems. Nowadays, suited locations become rare due to concurrency with tourism, offshore wind farms or nature reservations. All open systems are characterized by the immission of fish sewage, non-native species and drugs (e.g. antibiotics) that are used to increase health and growth of the fish. In addition, trained staff is needed. Furthermore, transport from the location of the production to the consumer is long, cost-intensive and environmentally unfriendly. **Closed recirculating aquaculture systems** – RAS – can be set-up far away from coastal regions. Disadvantages of today’s large-scale RAS are high investment- and high operation costs and their complexity. Water is reused, and fish cultivated under controlled conditions. However, controlling the living conditions in a closed system is a challenge and specially trained staff is needed.

The SEAWATER Cube sets a new standard in terms of aquaculture as a fully automated, ready-to-use and cost-efficient system for the cultivation of location-independent marine fish. Immissions are almost completely excluded and the water demand is only 1% clearly outperforming common RAS that exchange 10% of the water per day. Through the small-scale concept of producing around 7 tonnes of fish per year, the SEAWATER Cube is the only solution offering local and fresh marine fish, even in non-coastal regions.
MARKET POTENTIAL

Today’s situation, put in a nutshell, is that there are too few fish for too many people. Worldwide, fishing and aquaculture contribute to the population’s food resources. In the past years, fishing (capture) reached saturation due to overfishing and limited resources. Analysing the market conditions and growth rate in-depth, we see that independently from overfishing, the consumer demand for fish is increasing. World fish production is projected to reach 194 million tonnes in 2026 according to the FAO representing a total increase of 26 million tonnes. This means an increase in fish consumption by 19% compared to the current consumption. Aquaculture will increase by almost 100% by 2020 according to a study of the EC. The FAO forecast of world aquaculture growth is 7% p.a. for Europe and 34% worldwide, making aquaculture one of the fastest growing food sectors.

World production in 2015 (in 1,000 t, source: EUMOFA 2017)

<table>
<thead>
<tr>
<th>Country</th>
<th>Fishery</th>
<th>Aquaculture</th>
<th>Total production</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>17,853</td>
<td>61,536</td>
<td>79,389</td>
<td>38</td>
</tr>
<tr>
<td>Indonesia</td>
<td>6,565</td>
<td>15,649</td>
<td>22,215</td>
<td>11</td>
</tr>
<tr>
<td>India</td>
<td>4,862</td>
<td>5,238</td>
<td>10,100</td>
<td>5</td>
</tr>
<tr>
<td>EU 28</td>
<td>5,144</td>
<td>1,307</td>
<td>6,451</td>
<td>3</td>
</tr>
<tr>
<td>Vietnam</td>
<td>2,757</td>
<td>3,450</td>
<td>6,208</td>
<td>3</td>
</tr>
<tr>
<td>USA</td>
<td>5,045</td>
<td>426</td>
<td>5,471</td>
<td>3</td>
</tr>
<tr>
<td>Peru</td>
<td>4,839</td>
<td>91</td>
<td>4,930</td>
<td>2</td>
</tr>
<tr>
<td>Japan</td>
<td>3,553</td>
<td>1,103</td>
<td>4,657</td>
<td>2</td>
</tr>
<tr>
<td>Russia</td>
<td>4,454</td>
<td>153</td>
<td>4,617</td>
<td>2</td>
</tr>
<tr>
<td>Philippines</td>
<td>2,155</td>
<td>2,348</td>
<td>4,503</td>
<td>2</td>
</tr>
<tr>
<td>Norway</td>
<td>2,441</td>
<td>1,381</td>
<td>3,822</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>34,400</td>
<td>6,231</td>
<td>41,394</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>104,635</td>
<td>106,094</td>
<td>211,511</td>
<td>100</td>
</tr>
</tbody>
</table>

Asia reacted to the deficit in fishery supply by massively developing aquaculture. Production there is 2.8 times higher than supplies by fishery. Unfortunately, aquaculture in Asian countries takes place in extensive and labour-intensive farms with massive sewage production focussing on export requiring high expenditure of human labour. In Europe there are hardly any new building permits and human labour is expensive. Thus, in Europe, fishery production is still 3.9 times higher than aquaculture production. In total, fish production in the EU is only 6% of that in Asia and the annually trade deficit is €19.6 billion. EU self-sufficiency dropped from 47.4% to 46.0% and EU import prices increased by 27% from 2015 to 2016. Hence, the European Union strives for two goals: Firstly, the EU aims at stopping the decrease of employment in the fishing industry which declined by 19% between 1990 and 1997 because of measures taken to conserve stocks and reduce overfishing. And secondly, being the world’s largest importer of fishery products, the EU intends to increase its self-sufficiency with fresh fish.
MARKET POTENTIAL

The average European consumes 25.1 kg fish or seafood per year – 6 kg more than in the rest of the world. People are aware of the importance of protein and recognize fish as a crucial component of a healthy diet. The FAO investigated the prospects for fish and fishery products. Projections show an increasing demand per capita to 27 kg per year, resulting in a net supply of 1.6 million tonnes by 2030. According to the EUMOFA EU consumer habits study there is an increasing awareness of fishery and aquaculture products among younger consumers. In the final report of the EU consumer habits the EUMOFA identified furthermore a trend to “sustainable consumption”. Consumers demand shorter distribution channels to provide mainly to intermediaries, other buyers, and restaurants and they demand fish from sustainable sources.

Besides this trend, consumer prices increased between 2011 and 2016 by 16%. In total, European citizens spent €54.8 billion for fisheries and aquaculture products in 2015. Per capita household expenditures reached €107 in 2015 according to the EU Fish Market report, edition 2017, see Figure 10. People are willing to pay higher prices for fish due to the increasing awareness of its healthy aspect. Aquaculture products have been increasing in the past years and are forecast to increase value by 53% between 2000 and 2024. According to this, the market conditions are in favour for aquaculture as the growing market size in total amount of fish goes along with the increasing fish prices. This means, the total increase in consumed fish is boosted by the growing prices, making aquaculture extremely lucrative in the long run.

The total European market for fishery products is composed of freshwater fish, marine fish, crustaceans and molluscs and exceeded 14.56 million tonnes (EU production plus imports) in 2015, representing a trade volume of €54.8 billion. The market for marine fish represents 10.92 million tonnes per year (related to the world trade volume of 75% of seafish, 5% fresh water fish and 20% crustacean and molluscs). Hence, we address a high-volume market with a continuous growth of 2.93% by 2020.

The aquaculture market in the EU is also growing fast. In 2015, 1.31 million tonnes of farmed fish were sold and reached the highest value ever registered with €4.14 billion which meant an increase by 8% compared to 2014. In a first step, SEAWATER Cubes GmbH addresses, within the aquaculture market, the segment of sea bass and gilthead seabream. They are nearly exclusively produced in aquaculture (in net ponds polluting the Mediterranean Sea) as wildlife stock is close to extirpated and make out 20% of the total value of EU aquaculture production. 175,000 t of those two species are farmed every year in the EU being equivalent to 25,000 SEAWATER Cubes.
SEAWATER SERVICES

1. Plant construction
During the production of the SEAWATER Cube we, on the one hand, install filter components developed and patented by us. On the other hand, we use individual components of the aquaculture technology from well-known, almost exclusively German manufacturers and assemble them according to our successfully tested cycle scheme. In this way we provide the fish with the best possible water quality meaning ‘ocean quality’. After the pre-assembly of the three container modules, the plant is equipped with our automation solution. This software will perform the majority of activities and operations during the farming process by using intelligent control commands to ensure that the desired process parameters are always maintained. In addition, each cube is integrated into our company’s own cloud, so that the process and production data of each cube are available to the SEAWATER headquarter constantly and in real time. This gives us the opportunity to accompany you during your production process and our experienced staff will provide the best possible support. After all electrical installations, the three container modules are transported to your site by truck and connected on site within one day to a functional unit. Our installation service includes the first commissioning of the cube as well as the initial instruction in technology and operations.

2. Service
In addition to the advantages that we offer you with the system, it is our top priority to provide you with the best possible support during the farming process. In this way, we want to ensure the quality of the end product on the one hand, but also your satisfaction and economic success on the other. In addition to the plant construction, our service also includes the maintenance and servicing of your cube as well as training of you and your employees. In order to guarantee a failure-free operation, our emergency service is available around the clock by telephone. In addition, we can provide you with comprehensive support on marketing and sales issues, if needed. We regulate our services within the scope of a service contract.

3. Supply of feed, seedlings and additional materials
In order to guarantee the high quality of the fish produced, all raw materials used in the SEAWATER Cube - seedlings (young fish), feed and additives - must be selected diligently. We take care of this selection for you and ensure that the ordering and delivery process runs smoothly. This means that you have no additional administrative work and that you can concentrate fully on the animals. You will always have the necessary materials when they are needed. You further do not have to worry about the special safety precautions that have to be taken and observed when transporting seedlings to their destination. We will take care of the transport of the seedlings from the hatchery to your farm, so that the mortality risk during transportation is minimised and the planned production quantity is ensured.
FISH SALES

Actual market price in Germany
Sea bass with standard quality
whole, gutted, from aquaculture in Greece
19.98 € / kg

Actual market price in Germany
Sea bass organic
whole, gutted, from certified aquaculture in Greece
30.00 € / kg

We are aware that the sale of fresh fish is a challenge for our potential customers. Therefore, we would like to support you optimally with this topic!

There are a variety of distribution options for organic fresh fish.

- Own farm shop
- Farm shop of a friend
- Stalls and booths
- Own online shop
- Stationary fish shops
- Online-food retailers
- Food chains (Edeka, Rewe, Metro)
- Organic markets
- Nordsee
- Deutsche See
- Fish processing companies
- Fish restaurants
- Fine gastronomie / starred restaurants
- Sushirestaurants & -chains
- Hotels & hotel chains
- Caterer

When you become a partner in our network, we offer you marketing and sales support. Specifically, we help you to find sales opportunities that are tailored to your individual needs. We for example can provide you with contacts from potential customers or represent you in negotiations our work out with you individual marketing concepts.
FISH SALES

- **21,000** Fishes per year
- **1,750** Fishes per month
- **405** Fishes per week
- **55** Fishes per day

- **4** Customers à 1.525 kg / year
- **3** Customers à 2.033 kg / year
- **2** Customers à 3.050 kg / year
- **1** Customers à 6.100 kg / year

With a production volume of 7.35 tonnes, you will receive around **6100 kg** of gutted and ready-for-sale fish. We are currently planning one to two fishing operations per week in the SEAWATER Cube, so that both - the quantity of fish to be delivered and the amount of work involved - are manageable. Apart from that, the cohort stocking plan gives you the option of shifting the fish off in a time window of four months, depending on customer demand.

The **direct sale** of fish is especially profitable because large margins can be achieved here through marketing the USPs of the product: regionality and freshness. Also the absence of intermediaries helps you to reach higher profits. We offer you assistance in establishing trade cooperations and/or establishing your own marketing and distribution channels.

**Shelf life of fresh fish**

There are several factors that affect the **shelf life** of fresh fish. Basically saltwater fish can be preserved longer than freshwater fish. In addition, the treatment while catching the fish plays an important role. The more gentle a fish is caught, killed and treated, the longer its quality can be preserved. Continuous cooling is also essential to ensure freshness. Exempted fish should always be stored and transported on ice. After the purchase, fresh fish can be stored in the refrigerator (covered on a plate with cling film) for 2-3 days in the coldest compartment at 0°C to 2°C.

So far, there is no regional direct distribution of fresh marine fish except on the coasts. Fish that we consume in Europe is currently imported from the Mediterranean Sea or from overseas via plane and thus transported several days (up to 2-4 days) and then offered another 1-3 days as a fresh product in food retail stores. In our SEAWATER Cube, you can fish on demand and guarantee **maximum freshness** up to 7-10 days to your customers. This fact is not only interesting for end consumers but particularly for gastronomy and food retail by helping them to minimise their losses.
PURCHASING A CUBE

Planned timeline

- Order of components: 6-8 weeks
- Assembly: 4-6 weeks
- Fish farming: 12 months
- Purchasing contract
- Deposit (40%)
- Start of construction
- Interim payment (40%)
- Delivery
- Initial operation & first fish stocking
- Final payment (20%)
- 2nd stocking
- 3rd stocking
- Start of fish sales after ~10 months

Actions to prepare the commissioning of the farm

- Clarifying financing and funding opportunities
  - z.B. Bank or Chamber of Agriculture, funding programs?
- Applying for a building permit
  - Local construction office
- Taking evidence of expertise
  - Clarify with regional office for consumer protection
- Requesting for disposal of fish waste
  - Municipal disposal association
- Pouring the foundation / basement
  - When installation on green space; strip foundation is sufficient
- Finding distributors / buyers
  - Regional gastronomy and food retail, direct marketing?
- Planning logistic processes
  - Transport of the fish, routes & equipment
- Founding new company?
  - Outsourcing the new business may be reasonable
"Innovation is the ability to see change as an opportunity, not a threat... and it distinguishes between a leader and a follower"

Steve Jobs
Find more information on our website www.seawatercubes.de.