InnoAquaTech report.

Regional pilot – Zero emission RAS system in Klaipeda

Table of contents

1. Introduction

Project InnoAquaTech aims to implement **four successful** pilot projects, which will showcase the viability of a strong aquaculture economy in the South Baltic Region. These projects will also serve as **decision support** for potential investors and the project itself will be a truly useful service for SMEs. As a result, SMEs and their support organisations will gain **increased innovation capacity** as well as being able to develop and implement **cross-border value chains**. This in turn will help to strenghen the South Baltic area's aquaculture sector and contribute to more sustainable food production.

Existing aquaculture business models, lack of profitability and are not considered as attractive investment in South Baltic Sea region. That is justified by the fact that aquaculture industry in the region is experiencing a stagnation or decrease in all of the countries of SBSR.

To investigate new aquaculture business models that would be focused on high value species and sustainable energy resources there were the pilot in Klaipeda initiated. Pilot has been designed for cultivating shrimp " *Litopenaeus vannamei*" by utilizing alternative energy sources. Parts of the South Baltic Sea region has sufficient low temperature geothermal energy resources, that can be efficiently utilized to supply heat for large scale RAS systems dedicated to warm water marine species. This type of business model would gain 2 major competitive advantages: sustainable and competitive energy resource; high value species that can be delivered exceptionally fresh compare to imported product.

As geothermal resources can be used only on the high scale RAS systems, in the pilot has been implemented integrating solar panels as an energy source. The calculation and analysis has been made for establishing 1000 t RAS for shrimp cultivation

In order to institutionalize the knowledge gained during the implementation of the pilot and to ensure, the durability of the concept partner has signed cooperation agreement with Klaipeda university to create Klaipeda University aquaculture competence center on a basis of established infrastructure.

2. System design and functions

In order to ensure that pilot would create sufficient knowledge on operation of the shrimp RAS system, we have selected a medium size of infrastructure with the volume of 400 Kg of shrimp production per cycle, water capacity up to 50 m3.

Specification of the RAS system.

Name	quantity	Waterlevel [m]	diameter [m]	height of basin [m]	Bottomarea per basin [m²]	Capacity [m³]
Basin ongrowing	6	0,95		1,1	30	28,5
Basin pre-growing	1	1	3,39	1.5/1.2	9,0	9,0
					Subtotal (capacity for shrimp)	
Reservoir	1	1,1	2,7	1.44/1.2	5,7	6,3
Biofilter (same as reservoir)	1	1,1	2,7	1.44/1.2	5,7	6,3
Drum filter Polymare M620 (ca. 1,5m³)	1				0	0
					Total excl. Piping	
piping	Charge to volume of components			20%	Total incl. Piping	
Pumping capacity for basins			Comment			
water circulation basins	1,75	x per hour	1 time/hour needed for normal operation, security surcharge 75%			
highest waterlevl (ca.)	1,5	m				
head loss piping etc. (ca.)	2	m				
total pump capacity	115,5	m³/h				
total head	3,5	m				
available pump	Flow Rate	total head				

Speck Badu resort 110, AK-SSV	105 m³/h (ca. 125)	10 m (5m)				
Puping capacity for biofiltration			Comment			
water circulation basins	3	x per hour	hydraulic retention time (hrt) of 20 min			
highest waterlevl (ca.)	1,5	m				
head loss piping etc. (ca.)	2	m				
total pump capacity	18,9	m³/h				
total head	3,5	m				
available pump	Flow Rate	total head				
Speck BADU 90/30-AK-SSV	30 m³/h	8 m (5m)				
Puping capacity for bprotein skimming			Comment			
total pump capacity	52,0	m³/h	given by skimmer			
total head	3	m				
available pump	Flow Rate	total head				
Speck BADUresort 50-Ak-SSV	50 m³/h	10 m				

The system is marine RAS, set for shrimp cultivation. It is close to production scale system that can be used for developing operational knowledge, also experimenting with other biological models.

Water cleaning system,

Shrimp cultivation facility.

3. **Shrimp cultivation- process information**

During the implementation of the pilot, we have performed the cultivation of ""Litopenaeus *vannamei"* in the RAS , developing the operational knowledge that can be later provided to the companies interested in establishing such type of facilities.

Data from experiment has been shared with 9 companies and is provided in this report:

- Grow out rate during the experiment:

60 days		110 days		175 days	
Weight groups	Percent (%)	Weight groups	Percent (%)	Weight groups	Percent (%)
0,5-4,9 g	55,8441558	1-4,9 g	9,493670886	10-14,9 g	2,51572327
5-9,9 g	29,8701299	5-9,9 g	15,18987342	15-19,9 g	3,14465409
10-14,9 g	11,6883117	10-14,9 g	35,44303797	20-24,9 g	6,28930818
15-19,9 g	2,5974026	15-19,9 g	18,98734177	25-29,9 g	23,2704403
		20-24,9 g	14,55696203	30-34,9 g	30,8176101
		25-29,9 g	6,329113924	35-39,9 g	19,4968553
				40-44,9 g	10,6918239
				45-49,9 g	2,51572327
				50-54,9	1,25786164

- Calculations of costs for 1000 T shrimp facility with the installation of geothermal power plant

Costs	Quantity	Price
Water	50000 m3 + 2-5% 24h	0,05mln.
Mineralization: NaCl- 75.3 % MgCl-5,7% MgSO4-12,2% KCl-1,6% CaCl-4.6% NaHCO3-0,6%	7500t+2-5% 24h	1,5 mln
FCR	1,7 FCR	5,1 mln.
Larve	20000000	0,5 mln.
Pumping power	0,03 kv/m3 – 1,5 Mw	0,6 mln.
Electricity lights	0,03 kv/m -1,5 Mw	
Oxigen	1,5kg-1 kg shrimp	0.14 mln.
Heating	20 Mw	0,07mln
Invetment	20 mln.	
CPEX – Geothermal heating	10 mln.	
Pay back of investment 5 years		6000000
Price per kilo	1000000	13,84Eur/kg

- Shrimp samples

- Results of sensory analysis of shrimps from Lithuania performer by NMFRI

The batch of shrimps from RAS in Lithuania (Pilot 1) was delivered whole and fresh, iced (Fig. 1). The shrimps were in very good condition. During the survey, the quality changes of whole and headed shrimps were tested. The half of analyzed batch of shrimps was headed and the average mass of the headed part of batch amounts 15.31 ± 2.08 g and the average yield of it was 65.24 ± 1.98%.

Fig.1. The analyzed batch of shrimps from Lithuania (Photo credit: Olga Szulecka).

The results of the morphometric analyzes of shrimps from Lithuania are presented in the Table 1, whereas of sensory tests on the figures 2 and 4.

Table 1. Average mass and length of analyzed shrimps from RAS from Lithuania.

Parameter	**Lenght [cm]**	**Mass [g]**
Average ±SD	15.53±0.78	25.81±3.02
X_{min}	14.00	21.50
X_{max}	17.00	30.69
The total number of the shrimps in analised batch [pcs]	16	
The number of the shrimps in kg [psc/kg]	38.75	

A B

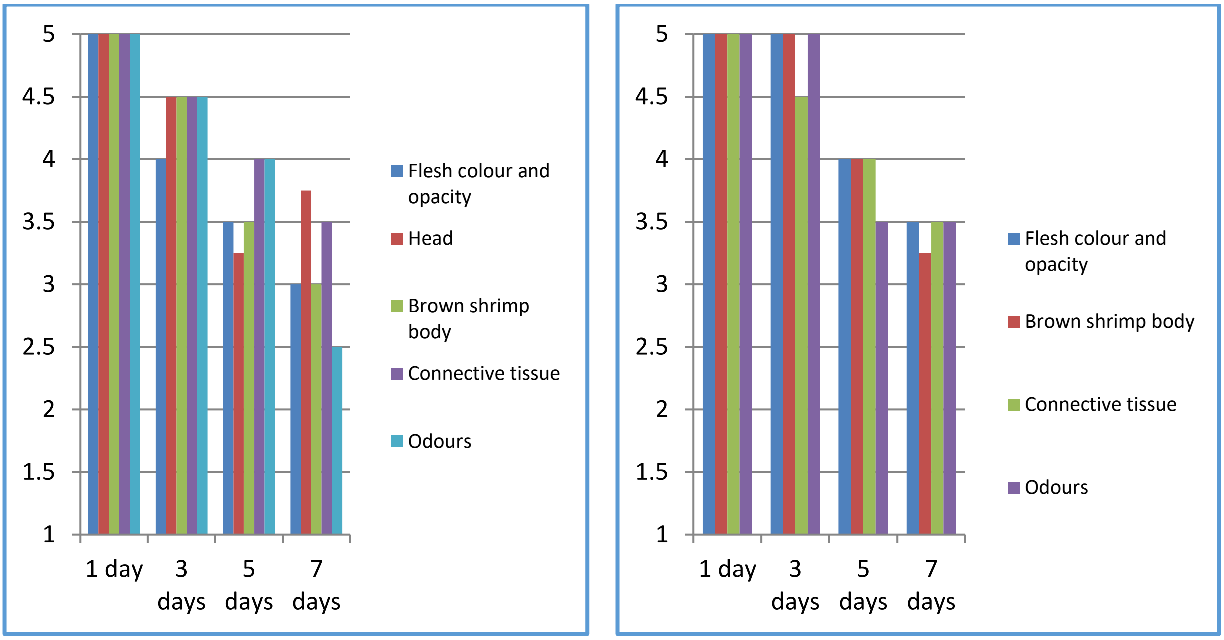
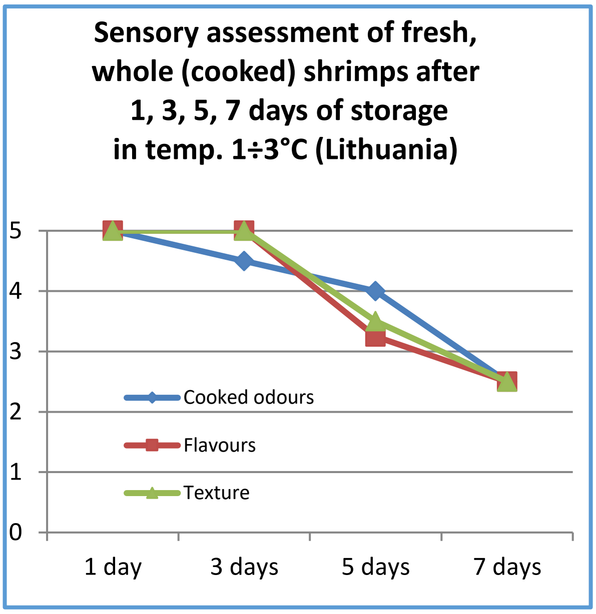


Fig. 2. Sensory assessment of fresh (raw) of whole (A) and headed (B) shrimps from RAS in Lithuania after 1,3,5 and 7 days of storage in temperature of 1÷3°C.

A B

Fig. 3. Fresh (raw) shrimps from batch from RAS in Lithuania after 1 (A) and 7 (B) days of storage in temperature of 1÷3°C (Photo credit: Olga Szulecka).

A



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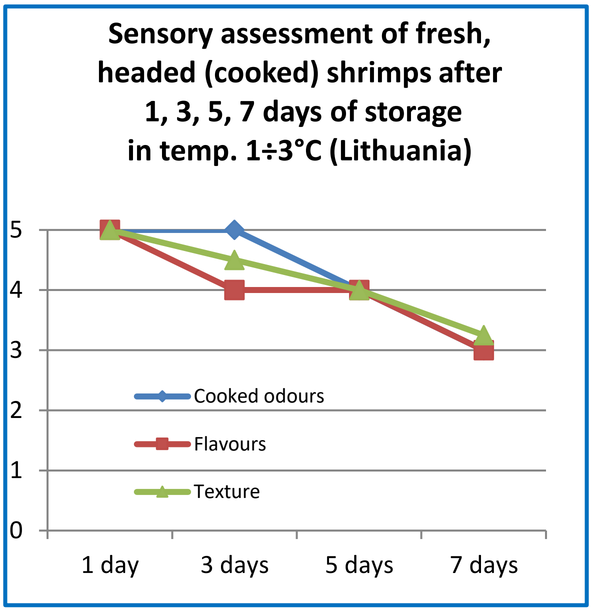

Fig. 4. Sensory assessment of fresh (cooked) whole (A) and headed (B) shrimps from RAS in Lithuania after 1,3,5 and 7 days of storage in temperature of 1÷3°C.

A

B

Fig. 5. Fresh (cooked) shrimps from batch from RAS in Lithuania after 1 (A) and 7 (B) days of storage in temperature of 1÷3°C (Photo credit: Olga Szulecka).

4. Conclusions

- Establishing a high value aquaculture product business models, can increase regions aquaculture industry competitiveness. This would provide high quality, fresh sea food for the consumers, would foster business growth for the equipment provides and would have significant impact to the environment globally, pushing producer’s world vide towards more sustainable aquaculture.
- Economic calculations on big scale 1000 t cultivation of shrimp applying geothermal energy resources has indicated a competitive business model. The price per kilo at 14 Euros a kilo could be economically attractive, the size of the farm would increase a supply of high value organic shrimp in EU.
- The major cost factors such as feed, mineralization, CAPEX can be decreased by volume. There fore the economic performance of shrimp cultivation, can become better.
- Technological development for big scale RAS is still in demand since there is no fixed solution for big scale shrimp cultivation facility.
- After the harvesting we have implanted several tasting sessions involving, culinary professionals. The product has received the best rates in taste as structure parameters, the preliminary market indications are that there is a niche for a high value quality product.
- The shrimps from Lithuania were in very good condition when were delivered and also after 7 days of storage and can be eaten by consumers for the whole analysed time of storage. The higher ranks were obtained by the headed shrimps (both raw and cooked), which allows saying that heading of shrimps is very important to maintain the quality during storage.