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Report on technical advancement and difficulties met D4.1

Ecoponics

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Technical advancement

The objective of WP4 is to design a large scale aquaponics production system utilizing the abundant geothermal and water resources in Iceland and establish the first pilot production unit. The first pilot units built in Iceland have been based on simple setups to learn about the nutrient balances, mass balances and energy use, and how to maintain a healthy and well-functioning aquaponics system. The systems were based on raft systems for leafy greens and grow bed for fruity plants, see examples on Figure 1.

	Fish tank: 600 L with tilapia Raft system: 2.4 m^2 with mint, basil and coriander Filter: 100 L solid filter and 100 L biofilter FCR: 0.92 Mass balance plant/fish: 1.25
	Fish tank: 1000 L with tilapia Sump tank: 400 L Raft system: 6 m^2 with mint, basil, coriander and dill Filter: 100 L solid filter and 200 L biofilter FCR: 1.05 Mass balance plant/fish: 0.95
	Fish tank: 1000 L with tilapia Sump tank: 600 L Grow-bed: 2 m^2 with tomatoes and peppers Filter: 100 L biofilter FCR: Not measured Mass balance: Not measured

Figure 1: Three of the pilot units at Svinna.

The tests so far have been run with Nile tilapia, *(Oreochromis niloticus)* imported from Fishgen in UK. Tilapia is a tolerant warm water fish and is the most popular fish in aquaponics systems. It is easy to breed, grows fast, tolerates a wide range of environmental conditions and has a nice white flesh of good quality. Heating the water with geothermal heat serves as an advantage for farming warm water species in Iceland. Thus, tilapia was the chosen fish species for the system.

Presentations towards the aquaculture industry have also led to discussions about other fish species farmed in Iceland such as Arctic charr and rainbow trout. With decoupled systems both species offer valuable opportunities, but in simple integrated aquaponics systems rainbow trout would offer a better tolerance to changes in the environment. The research institute Bioforsk in Norway is carrying out tests using rainbow trout in their aquaponics system and the EcoPonics group follows the results and is in close dialogue with their experts.

The plants tested so far include basilica, mint, coriander, dill, rucula, mixed salad, okra, tomato, cucumber, aubergine, pepper and strawberries. Most of them have grown well.

The main water parameters, temperature, pH, dissolved oxygen, carbon dioxide, electrical conductivity, total dissolved solid, ammonia, nitrite, nitrate and iron, have been monitored. Calcium, potassium and iron have been added to the system and the pH has been adjusted to appr. 6.8.

Based on the results so far it has been decided to build the next steps on simple production modules and expand step by step, learning from own experience and the general development within aquaponics.

Small office units were set up in the Iceland Ocean Cluster in Reykjavik, illustrating the concept and presenting the project to the many Ocean Cluster visitors.

Certification and marketing issues related to aquaponics and organic production have been discussed with certification specialists and organic farmers. Furthermore, the project has been presented to other businesses both in aquaculture and horticulture, to research partners, several municipalities and governmental bodies.

Difficulties met and future opportunities

During the start-up phase some problems occurred keeping the system stable. This has been solved and all systems have been running well. The main problem during the start-up was the long distance between the greenhouse and the people driving the project, especially due to the learning curve, both regarding the design, the monitoring of environmental parameters, growth rates and stability of the systems. It was decided to use an available greenhouse in the capital area and this was a breakthrough as it was absolutely necessary to follow the systems closely during the first year. Therefore, the first steps were carried out in pilot units made of low cost materials that could easily be moved. However, it is still planned to build the future systems outside the capital area with better expansion opportunities.

The findings so far are mainly on feed conversion ratio, mass and energy balances and the choices of species and growth rates. Also the monitoring of critical environmental parameters have been successful. Adjustments have been made to keep pH within limits and necessary

additions of iron, calcium and potassium have been carried out. The biofilters have in all cases been running well. The sediment tanks have also been effective, however these have been improved and need further improvements to decrease the labour intensiveness for their cleaning. During the next steps the sediment tanks will be made larger with more compartments and a bead filter will be included to improve the filtering of small particles. When the system becomes larger a drum filter will be included.

Discussions with the aquaculture industry in Iceland, IGFF and AkvaGroup in Denmark, one of the main supplier of RAS systems globally, and based on positive results on farming rainbow trout in aquaponics by Bioforsk in Norway, have led to ideas using rainbow trout in commercial aquaponics systems and couple modern RAS to high-tech hydroponics in large scale. This would be based on so-called “decoupled” aquaponics technology allowing optimum conditions for both plant and fish species. This can provide new opportunities for future development.

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