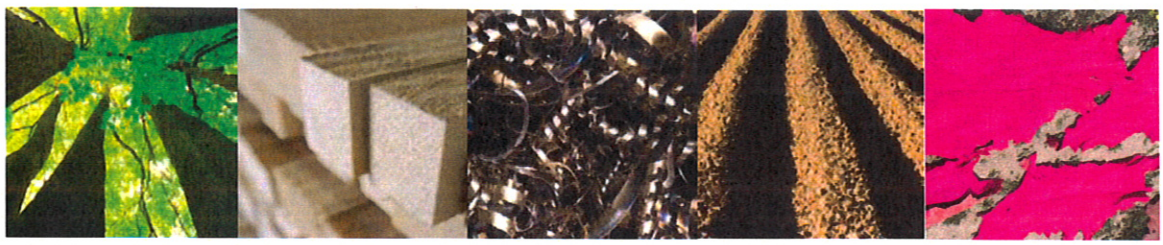

ECO-INNOVATION
WHEN BUSINESS MEETS THE ENVIRONMENT

CIP Eco-innovation
Pilot and market replication projects
Call 2012

Call Identifier: CIP-EIP-Eco-Innovation-2012

Progress Report

EcoPonics

Contract ECO/12/332783/SI2.656985

Covering the reporting period from
18/07/2013 to 17/05/2014
Reporting Date
12/06/2014

Project coordinator: Dr. Ragnheidur Thorarinsdottir
Project website: http://aquaponics.is/ecoponics/

eaci executive agency for competitiveness & innovation

European Commission

cip competitiveness and innovation framework programme

1 Progress of work plan in the period

1.1 General progress

The project has had a good start. The three SMEs have been designing and building aquaponics units in the respective countries. Breen has built the new hatchery at Tknika and is starting the operation. In Iceland warm water fish has been imported from UK and the first aquaponics units have been built. Some difficulties have been encountered in the start-up phase due to a very low buffering capacity of the Icelandic water but the problem is solved and the systems are now running in good balance. For pH stabilisation carbonate (CO_3^{2-}), calcium (Ca^{2+}) and potassium (K^{+}) as hydroxides are added into the water. In Denmark Ballerup municipality has been replaced with Copenhagen municipality, as Copenhagen has designated a whole neighbourhood for the promotion of Urban Demo farms, green roofs and job creation. Preparations of a 50 m^2 test plant resembling the urban roof farm has been made together with AgroTech Ltd. and AkvaGroup Ltd.

Two physical meetings have taken place, the first in September 2013 visiting aquaponics entrepreneurs in Norway and the second meeting was held in combination with an aquaponics seminar in Iceland on March 25th 2014. A project website has been designed, http://aquaponics.is/ecoponics, where public information and news about the project and its progress is presented. The project has also been presented in the annual University of Iceland Magazine as well as public media - including radio and newspapers, for municipalities and ministries, aquaculture and horticulture businesses, at conferences and in journals. Also, the project consortium has broadened its global aquaponics network by active participation in the COST action on aquaponics that started this year.

1.2 Progress on all work packages against initial objectives

Del. N° [1]	Deliverable name [1]	Type[1]	WP N° [1]	Delivery date from Annex I [1]	Delivered (yes/no) and status (draft/final)	Submission with report[2]	Forecasted delivery date	Comments on progress
D2.1	Report on technical advancement and difficulties met	Report	WP2	M8	yes/final	PR1	M9	According to plan
D3.1	Report on technical advancement and difficulties met	Report	WP3	M8	yes/final	PR1	M9	According to plan
D4.1	Report on technical advancement and difficulties met	Report	WP4	M8	yes/final	PR1	M9	According to plan
D6.1	Project information updates	Project information sheet	WP6	M1	Yes / updated regularly	PR1	M1	According to plan
D6.6	Project Website	Website	WP6	M6	Yes / updated regularly	PR1	M6	According to plan
D6.7	Project Dropbox	Internal website	WP6	M1	Yes / updated regularly	PR1	M1	According to plan
D6.8	Presentations in public media, handout materials, seminars/conferences and industry journals	Presentations	WP6	Regularly	Yes / see list below	PR1	At least three times a year by each country	According to plan

[1] This information must be identical with your List of Deliverables in Annex I of your Grant Agreement.

[2] Please indicate the report with which you have submitted the deliverable (PR1, IR, PR2,…).

WP1 Project management

The project has had a good start and the consortium works well as a team. The communication has mainly been through web based media (e-mail and Skype and through the project Dropbox installed in M1). The first physical meeting was held in September 2013 in relation to a visit to the aquaponics test center under development at Bioforsk in Norway. The meeting contained partner presentations, discussions about the project and vocational training programmes as well as a visit to aquaponics facilities in Evje. The second physical meeting was held in Iceland on March 24th in connection with an aquaponics seminar on March 25th. All partners presented their work at the seminar. It was very successful with appr. 70 participants from nine countries covering the aquaculture and horticulture industries, organic farmers, certification businesses, academia and civil cervants.

WP2 Upscaling and optimization of BREEN Technology

The main task of WP2 in this reporting period, includes an optimal design of the commercial plant, taking into account optimal harvesting at least once a week all-year round, driven by the market need. Focus is on environmentally friendly production and full use of all resources. The key to this is a healthy and balanced polyculture system. Thus, the feed is 100% based on sustainable ingredients, no synthetic fertilizers will be used for the plant production and no effluent water or waste will leave any of the production units.

During the first ten months of the Ecoponics project efforts have been focused on design and investigating the formulation of the feed for the fish. The construction of the hatchery and fattening in the new location at Tknika has started and the hatchery is ready. Emphasis is on sustainable energy use such as biomass heating and solar energy.

Fish feed:
Commercial fish feed from Skretting, Biomar and Le Gousant have been compared. The process of analysis has been carried out as follows:

- Chemically (through analysis in a laboratory)
- Biologically (tested in fish)

The future plan is to develop new fish feed formulas without fish protein using proteins from insects, worms or other sustainable sources.

Equipment:
The construction of the installations began in January 2014; the main costs incurred until now and the main suppliers, are:

- Construcciones Iñadi, working in the indoor installation of the hatchery:
  - Fish tanks
  - Hatchery fish tanks
  - Mechanical filtering system
  - Water and heating system for production
  - Aquaponics tanks design and CAM

  - Installation of RAS and heat
- PcComponentes, computers and components for the control system
- Coralleida, profilux control system

WP3 Smart Eco System management and urban food production

Ballerup municipality has been replaced with Copenhagen municipality for cooperation on urban aquaponics. Copenhagen municipality has designated a whole neighbourhood for the promotion of Urban Demo farms, green roofs and job creation. On the 6th of February 2014 the municipality agreed to provide a 1,200 m^2 roof and approximately 270.000 Euro for building a platform to carry the urban aquaponic roof top farm, as well as building an outdoor lift and roof-top fencing for security when people are visiting the place. The roof will be shared with another company trying out various open beds; the roof will hence represent and demonstrate the whole spectre of urban farming from small vegetable/flower beds to commercial urban food production.

IGFF and Copenhagen municipality have agreed on a ten year lease free of rent, but costs on heating and electricity will be paid by IGFF. Copenhagen has been selected as the Green Capital of Europe in 2014[1], and therefore there is a strong interest in the municipality of backing up the urban roof top farm as a show case of sustainable food production. Likewise, a tight command line in the administration to secure a rapid approval of the necessary permissions from different departments has been organized within the municipality.

While negotiations with Copenhagen municipality have taken place, preparations of a test plant resembling the urban roof top farm has been made together with AgroTech Ltd. and AkvaGroup Ltd. AgroTech is an innovation institution operating as a link between companies and universities in Denmark within horti- and agriculture. IGFF will rent a 50 m^2 greenhouse cube within their large research greenhouse, and draw on their expertise in modern greenhouse production as well as support on various research designs for aquaponics. AkvaGroup is a large international aquaculture company with expertise on aquaculture equipment and fish production. Rectangular fish tanks have been made to fit underneath the mobile plant tables for testing the *economies of space* idea with the practical daily caretaking in aquaponics. The test plant will be in operation by the end of this summer and is planned to operate a whole year. The test plant is therefore expected to support and run parallel with the urban roof top production for trials, without jeopardizing the aquaponic roof top farm production.

Similarly IGFF has been working together with AgroTech Ltd. on modelling the symbiotic effects from aquaponics. The model is finished and aquaculture is now implemented into AgroTechs IKT simulation tool for measuring climatic change when installing aquaculture fish tanks into a greenhouse. The results showed a yearly reduction on energy usage for greenhouse heating at 21 %, contributed by the fish tanks operating as heating buffers during night. Similarly the CO_2 from the fish gave a 14% yield increase. A scientific journal article is being written on this work. Likewise, a margin account is in preparation 'translating' the

[1] http://ec.europa.eu/environment/europeangreencapital/winning-cities/2014-copenhagen/

modelling results on the symbiotic effects within aquaponics into economics. A journal article with these results is in preparation.

WP4 Renewable energy for food production with geothermal aquaponics

Tilapia fingerlings were imported to Iceland from Fishgen UK in August and December 2013 and small aquaponics units were built. The first plants being tested are basilica, mint, coriander, salad, tomato, pepper and strawberries. Some problems occurred in the start-up related to the low alkalinity of the very clean Icelandic tap water resulting in pH fluctuations. Addition of calcium carbonate ($CaCO_3$), calcium hydroxide ($Ca(OH)_2$) and potassium hydroxide (KOH) has solved the problem. Also direct use of low heat geothermal water has been tested. The geothermal water does neither seem to have negative effects on the fish nor plants.

Dissolved oxygen (DO), carbon dioxide (CO_2), nitrite (NO_2^-) nitrate (NO_3^-) and iron (Fe^{++}) have been measured. Furthermore, the water parameters (ammonia, temperature and pH) have been monitored online by an aquarium system from SENEYE. However, a better solution is needed for online monitoring of more parameters in the larger system. The Profilux system has been compared to other available systems on the market, for the development of a successful surveillance system and quotations have been obtained.

An old greenhouse was renovated during late summer and autumn 2013 with help from university students, a 200 m^2 aquaponics system was designed and the first unit was built. Three university students are working on the project this summer and it was decided to build units in an available greenhouse in Reykjavik for the next steps as it is too expensive to travel to the greenhouse from Reykjavik on a daily basis. Furthermore, small office units were set up in the Iceland Ocean Cluster in Reykjavik in January 2014, illustrating the concept and presenting the project at the Ocean Cluster which receives many visitors and has received a lot of positive attention.

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 in Iceland and the ministries of industry and innovation.

WP5 Exploitation and business plan

WP5 has not started.

WP6 Dissemination activities

EcoPonics has already been presented widely to aquaculture and agriculture business communities, regulatory institutions, scientific communities and to the general public in Spain, Denmark and Iceland. The project has been presented on web pages, in newspapers and radio, and also at seminars. A logo for the project has been designed and also a corporate

logo for the new installation by BREEN has been designed for improved marketing of the aquaponics idea.

Paul Rye Kledal, director of IGFF (Denmark) and Ragnheidur Thorarinsdottir and Kristin Vala Ragnarsdottir (both in Iceland) have been nominated as national representatives for Denmark and Iceland, respectively, on the Management Committee in the new European Cost Action program on aquaponics running from 2014[2].

A Project Information Sheet was delivered in M1 and the project website http://aquaponics.is/ecoponics was launched in M6. From this website the public can get access to general information about the project, press releases about the project's progress as well as public documents and reports of interest to the wider public. Other main dissemination activities are listed below.

- Interview in the local newspaper in Grimstad Norway, October 1st 2013
- Kledal, Paul Rye, Morgendagens By-landbrug [The Urban farms of Tomorrow], Grøn Hverdag no. 4/2013, pp. 16-18, 2013
- Kledal, P.R., Presentation on 'Aquaponics & Urban farming', Seminar at SLU University Alnarp Community, Sweden 11.12.13
- Kledal, P.R., Presentation at: 'Dyrk, Høst, Spis', [Grow, Harvest, Eat] Conference on Urban Farming and the edible city, Copenhagen 06.10.13
- Kledal, P.R., Lecture on: '500 years of Urban farming in Denmark', Grøn Hverdag, Copenhagen 21.01.14
- Thorarinsdottir, R.I., Aquaponics based on geothermal energy, 2nd NordicRAS in Aalborg, Denmark, October 9-11 2013
- Thorarinsdottir, R.I., Direct use of Geothermal Energy for new businesses, presentation at the University of Iceland, November 22nd 2013
- Interview in Casos de Éxito, BREEN, innovación en cultivos acuícolas, December 16th 2013 - http://work.noticiasdegipuzkoa.com/2013/12/breen-innovacion-en-cultivos-acuicolas/
- Presentation at Iceland Ocean Cluster January 17th 2014 – guests included politicians and civil cervants from municipalities, representatives from public media and the minister of industries and innovation in Iceland
- Morgunbladid (Icelandic newspaper) – January 23th 2014 - http://www.mbl.is/greinasafn/innskraning/?redirect=%2Fgreinasafn%2Fgrein%2F1494923%2F%3Ft%3D939238291&page_name=article&grein_id=1494923
- Tímarit Haskola Islands / University of Iceland Magazine, February 2014

[2] http://www.cost.eu/domains_actions/fa/Actions/FA1305

- Radio Interview in Bylgjan – I bitid, March 4th 2014 - http://vefutvarp.visir.is/upptokur?itemid=25090
- Interview in Utvegsbladid, March 4th 2014 - http://utvegsbladid.is/sameldi-i-husi-sjavarklasans/
- Visit of the President of Iceland, Olafur Ragnar Grimsson, to Iceland Ocean Cluster March 11th 2014
- Various presentations at the Aquaponics seminar at the ecovillage Solheimar in South Iceland on March 25th 2014
- Radio interview on RÚV – Rás 1, Sjónmál - http://www.ruv.is/mannlif/naeringin-flyst-fra-fiskum-til-plantna
- Interview at Natturan March 28th 2014 - http://natturan.is/samfelagid/efni/12580/
- Presentation at the Municipality of Reykjavik March 28th 2014
- Interview in the local newspaper "El Diario Vasco", about Breen and this project, April 16th 2014
- Presentation at the Municipality of Seltjarnarnes in Iceland, April 22nd 2014
- Presentation for representatives from Austurbru in East Iceland, April 28th 2014
- Presentation at the Municipality of Kopavogur in Iceland, May 20th 2014
- Further information at - http://aquaponics.is/ecoponics/?page_id=215

1.3 Identified deviations, problems and corrective actions taken in the period

Some disagreements came up in Denmark on sharing costs and risks between IGFF and Ballerup municipality. The problem was solved as Copenhagen municipality offered collaboration related to Urban Demo farms, green roofs and job creation. This has neither affected the time schedule nor the budget plan of the project.

In Iceland students from the University of Iceland have been working on the project. Due to high travel costs to the greenhouse farmers on daily basis – additional aquaponics units have been set up in Reykjavik.

1.4 Progress regarding performance indicators

The units built are closed-loop zero waste systems and all nutrients are fully used. No CO_2 is added to the plant system and no waste-water is taken out from the system. The heating is based on direct use of renewable energy and waste heat. In Denmark district heating will be used. No synthetic fertilizers are used, other than calcium carbonate and hydroxides for pH control and to add necessary Ca and K for the plants. Furthermore Fe-chelate is added to

provide necessary iron to the plants. Mass balance calculations will be carried out during autumn/winter 2014-2015.

2 Progress regarding market uptake and exploitation

EcoPonics market uptake and exploitation work will formally start in month 23 according to the time plan. However, the consortium has been very active in presenting the business idea to aquaculture, horticulture and organic farmers as well as to municipalities, public administration and the general public. Also the consortium members are actively participating in European networks on aquaponics and have established the Association of Commercial Aquaponics Producers (ACAP). Furthermore, the project will be well presented at the Aquaculture Europe conference to be held in San Sebastian, Spain, October 14-17 2014.

3 Work plan for the next period (max 1 page)

3.1 Planned activities in the next period

During the next period M11-19 the production units will start up in all countries, the production will be monitored and mass balances will be calculated. Comparisons will be carried out between the countries. A report on environmental parameters will be launched in M14 and a report on design and risk analysis will be ready in M18. Moreover, calculations on the economics will be carried out.

Further dissemination activities will be carried out. The project will be presented at the Aquaculture Europe 14 conference in Spain in M15. The project and its progress will be presented to the general public, industry associations, governmental institutes and researchers. Also the aquaponics network will further be expanded. A meeting with collaboration partners from Canada is planned in October and the group has been contacted by several aquaponics researchers and businesses from several other countries as Romania, Germany, Israel, Belgium, Norway, Africa and US.

3.2 Planned meetings, activities related to market uptake and dissemination activities

The next meeting will be held in October 2014 in San Sebastian Spain including participation in the Aquaculture Europe Conference that offers a special session on aquaponics. The report on environmental parameters will be launched and the main results so far will be presented at the conference.

In December 2014 the plan is to visit the aquaponics facilities that are starting up in Denmark during the next months. The main topics will be on mass balance calculations, design and risk analysis.

4 Other issues (max 1 page)

N/A

5 Overview on hours spent (template downloadable from our website http://ec.europa.eu/environment/eco-innovation/managing-projects/contract-finance/index_en.htm)

Please note that details on partners hours - although recommendable - are optional.
You may report only the total hours per Work Package

Project Hours (Partner / Workpackage)

ECO/12/332783/SI2.656985 EcoPonics	
Reporting period (M1 to M10)	
Deliverable (PR)	

Total Project Hours:	**34.360,0**
Total Spent Project hours:	**9.788,0**

Hours x Partners	WP1		WP2		WP3		WP4		WP5		WP6		WP7		WP8		WP9		**Total hours x Partner**	
	Annex I*	Spent**	Annex I*	Spent**	Annex I*	Spent**	Annex I*	Spent**	Annex I*	Spent**	Annex I**	Spent**	Annex I*	Spent**	Annex I*	Spent**	Annex I*	Spent**	Annex I*	Spent**
Partner 1 (Svinna)	1.200,0	440,0	200,0		200,0		6.700,0	779,0	500,0		300,0	122,0							**9.100,0**	**1.341,0**
Partner 2 (IGFF)	300,0	100,0	200,0		6.800,0	1.130,0	100,0		500,0		200,0	60,0							**8.100,0**	**1.290,0**
Partner 3 (Breen)	300,0	74,0	13.780,0	5.576,0	200,0		200,0		1.230,0		150,0	14,0							**15.860,0**	**5.664,0**
Partner 4 (HI)	300,0	169,0					800,0	1.032,0			200,0	292,0							**1.300,0**	**1.493,0**
																			0,0	**0,0**
																			0,0	**0,0**
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																			0,0	**0,0**
																			0,0	**0,0**
																			0,0	**0,0**
																			0,0	**0,0**
																			0,0	**0,0**
Total hours x WP	**2.100,0**	**783,0**	**14.180,0**	**5.576,0**	**7.200,0**	**1.130,0**	**7.800,0**	**1.811,0**	**2.230,0**	**0,0**	**850,0**	**488,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**		

% Project Hours already spent x WP (as compared to Annex I)									
	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9
Partner 1 (Svinna)	36,7%	0,0%	0,0%	11,6%	0,0%	40,7%			
Partner 2 (IGFF)	33,3%	0,0%	16,6%	0,0%	0,0%	30,0%			
Partner 3 (Breen)	24,7%	40,5%	0,0%	0,0%	0,0%	9,3%			
Partner 4 (HI)	56,3%			129,0%		146,0%			
Total % x WP	**37,3%**	**39,3%**	**15,7%**	**23,2%**	**0,0%**	**57,4%**			

* As originally proposed
** From M1 to the time of reporting.

Annex A – An updated version of the publishable project information sheet

Project Information Sheet

EcoFood from Aquaponics (EcoPonics)

Programme area:	CIP Eco-Innovation, First Application and market replication projects
Coordinator:	Dr. Ragnheidur Thorarinsdottir Svinna-verkfrædi ehf. (SVINNA), Iceland E-mail: svinna@svinna.is Tel: +354 8964830
Partners:	Breen Breeded in Green SL (BREEN), Spain Paul Rye Kledal – Institute of Global Food and Farming (IGFF), Denmark Haskoli Islands (HI), Iceland
Website:	www.aquaponics.is/ecoponics/
Benefits (max. 150 characters incl. space):	EcoPonics provides commercial Aquaponics - an environmentally friendly food production method that will be marketed for replication in Europe
Keywords:	Aquaponics, Sustainability, Food
Sector:	Green Business
Type of solution	Sustainable products, technology development, new service
Duration:	18/07/2013 – 17/01/2016
Budget:	€ 1,723,028 (EU contribution: 49.97%)
Contract number:	ECO/12/332783 SI2.656985

Summary

EcoPonics joins three innovation companies from Denmark, Iceland and Spain, respectively, collaborating with the University of Iceland with the aim to implement commercial and competitive Aquaponics production systems in all three participating countries. Aquaponics is a combination of the words aquaculture and hydroponics, and the eco-innovative technology behind is similarly a combination of the two normally specialized production systems, producing fish and plants in one production loop. The wastewater from the fish is used as resources in the horticultural production where plants take up the nutrients and hence cleanse the water before being returned to the fish, eliminating traditional use of fertilizers and minimizing use of water and energy. Thus, Aquaponics is a resource efficient and environmentally friendly food production system optimizing use of resources.

The EcoPonics partners will work towards dissemination and replication of the Aquaponics technique in Europe providing new high skilled jobs and sustainable high value food products.

Expected and/or achieved results

New and smarter Eco-innovative Life cycle technology solutions driven by European SME´s generating commercial based industrial showcases

Integrating modern food production with EU transition policies advocating for climate resilient and CO_2 neutral cities

New possibilities for direct use of renewable energy in industry

New sustainable food products locally produced in Europe

Waste products made into valuables

Annex B – Copy of the deliverables produces during the reporting period

- Report on technical advancement and difficulties met (D2.1, D3.1 and D4.1) – content included and updated in the PR
- Project website (D6.1) www.aquaponics.is/ecoponics/
- Project dropbox (D6.7) – internal website of EcoPonics
- Presentations in public media, handout material, seminars/conferences and industry journals (D6.8) – listed on the project website http://aquaponics.is/ecoponics/?page_id=215

REYKJAVIK 15.06.2014

CIP Eco-innovation
Pilot and market replication projects
Call 2012

Call Identifier: CIP-EIP-Eco-Innovation-2012

Report on technical advancement and difficulties met D2.1

Ecoponics

Contract ECO/12/332783/SI2.656985

Covering the reporting period from

18/07/2013 to 17/02/2015

Reporting Date

28/02/2015

Project coordinator: Dr. Ragnheidur Thorarinsdottir

WP2-leader: Fernando Sustaeta

Project website: http://aquaponics.is/ecoponics/

Technical advancement

The main task of WP2 includes an optimal aquaponics design of the commercial plant at Breen taking into account optimal harvesting at least once a week all-year round, driven by the market need. Focus is on environmentally friendly production and full utilization of all resources. The key to this is a healthy and balanced polyculture system. Thus, the feed is 100% based on sustainable ingredients, no synthetic fertilizers are used for the plant production and no effluent water or waste leave the plant.

During the first period of the Ecoponics project the efforts have been focusing on commercial aquaponics design. The hatchery and fattening units were designed in the new location and in the beginning of 2014 the hatchery was constructed.

The new units have run during 2014 including automatic surveillance and control of the main processes, in order to minimize the possible risks that could affect the production. This includes controlling the quality of the water, the proper and optimal feed, the corresponding maintenance and cleaning of the tanks, as well as a system of plant cultivation for an optimum filtration of the water. These factors are crucial to obtain a system of sustainable and safe production. The design of the system is described in D2.3 Report on design and risk analysis.

The new site is located in Tknika. Tknika is a centre promoted by the Basque Department of Education, Universities & Research, under the direct auspices of the Sub-Department of Vocational Training & Lifelong Learning. Innovation is at the core of Tknika in its ongoing efforts to place Basque Vocational Training at the European forefront. At Tknika there is good space for the production units, as well as a laboratory and hatchery. Tknika has offered BREEN more space than they assigned at the beginning of the project and therefore it will be possible to further expand and improve the installations.

Equipment:
The construction of the installations began in January 2014; the main costs incurred until now and the main suppliers, are:

- Construcciones Iñadi, working in the indoor installation of the hatchery:
  - Fish tanks
  - Hatchery fish tanks
  - Mechanical filtering system
  - Water and heating system for production
  - Aquaponics tanks design and CAM (Computer-aided manufacturing)
  - Installation of RAS and heat (recirculating aquaculture system)
- PcComponentes, computers and components for the control system, in the Check Office.
- Coralleida, profilux control system

The following tasks and installations have been carried out:

In the Hatchery:
- Recirculation and filtering pumps

- Water recirculation system
- Heating system of the water
- Thermal management system
- Aeration system of the water
- Breed Tanks
- Vegetal filtering system
- Controlled artificial lighting for plant growth

Control and handling of products:
- Laboratory for the monitoring of the quality of the feed
- Room for the handling of broodstock

Other:
- Junior and Senior Expert Office
- Control office
- Feed store

Furthermore, Breen has investigated the formulation of the feed for the fish. The feed from the main suppliers on the market has been investigated and alternative protein sources have been analysed.

Commercial fish feed from Skretting (Spain), Biomar (Spain) and Le Gousant (France) have been compared. The process of analysis has been carried out as follows:

- Chemically
- Biologically
  1. Tastefulness
  2. Acceptance
  3. Effectiveness

After that the development of a new fish feed formula without fish protein started using proteins from insects, worms or other sustainable sources.

Breen has also worked on the follow-up of the water qualities in aquaponic productions by analysing the pH, dissolved oxygen, redox, conductivity, temperature, NH3-N (Ammonia) and NO3-N (Nitrates) and the photoperiod. The environmental parameters have been related to the optimum choices of plant species and seasonal effects.

Difficulties met

Breen has not met any major difficulties and the project has been running according to the plan. The company has junior and senior experts responsible for the daily running of the system. The work tasks of Breen´s employees in the EcoPonics project are listed in Annex.

This publication has been produced with the assistance of the European Union. The contents of this publication are the sole responsibility of Svinna, Breen, IGFF and HI and can in no way be taken to reflect the views of the European Union.

Co-funded by the Eco-innovation
Initiative of the European Union

Annex: Work-tasks of Breen's employees

Breen has junior and senior employees taking care of the daily running of the system. The employees were responsible for the launching of the technical part of the project and on the other hand the initiation and maintenance of the hatchery and the plant cultivation. This includes also the surveillance and monitoring to keep the system in a good balance. The main work tasks are listed in the following.

-Maintenance and Control of the agricultural system

The Junior Experts, are responsible for the maintenance and control of the agricultural system and work shifts to cover the work to be carried out during the 365 days of the year. Among others, the tasks they realize are:

-Cleaning of the cultivation system
-Control of parameters
- PNT (Standardized protocol daily jobs) every day of the year, it makes the control of tasks, 2 times a day, in the morning and in the afternoon.
-Check temperature of the tanks
-Check temperature box primary electrical system
-Check water levels
-Check entry of water in the tanks
-Retro laundering filters, mandatory
-Review profilux alarms
-Fill feeders
-Check water level of osmosis
-Review aquaponia kits
-Check pc screens if there has been any anomaly
-Purges, mandatory, in the morning and in the afternoon
-Feed, mandatory
-Cleaning meshes, irons floating
-Minimum night temperature of the greenhouse
-Review outputs bacterial filters
And others

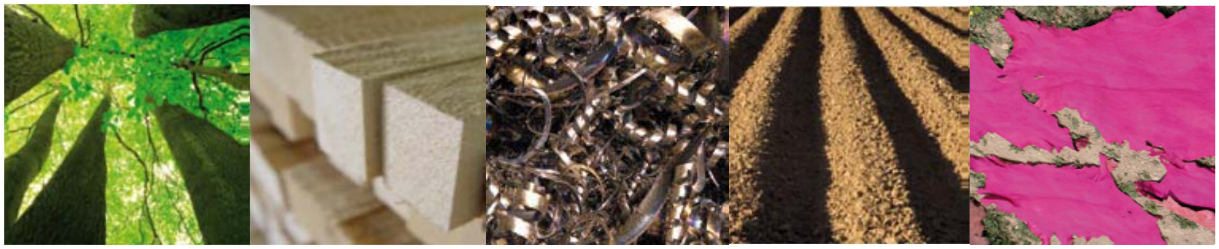
-Control the parameters of the water and management of the plant system

The experts are in charge of the control of the parameters of the water and management of the plant system and work together in the tasks. The expert also manages different kind of projects and in this case manages the project Ecoponics. Among others, the tasks they realize are:

-Check irons floating: temperature, pH, electrical conductivity, water exit, pump
-Ex clay: temperature in the tank, pH, electrical conductivity
-Water pipes: Temperature, pH, electrical conductivity, water level in the pipes
-Model-Demo: Temperature, pH, electrical conductivity
-Review aquaponia kit
-Review aquaponia kit (fishes)
And others

-Design of the system of feeding and breeding areas for the hatchery

The Senior Expert is responsible for the design of the system of feeding and breeding areas of the Hatchery.
Among others, the tasks he realizes are:
- Calculation of volumes of biomass
- Protocol of size of food (grain size) in relation to the size of the fish
-Development of planes
-Application for licenses of activity and permissions of works
-Subcontracting, request of budgets, financial and management issues
-Follow-up of work
-Environmental and other reports



CIP Eco-innovation
Pilot and market replication projects
Call 2012

Call Identifier: CIP-EIP-Eco-Innovation-2012

Report on on technical advancement and difficulties met D3.1

Ecoponics

Contract ECO/12/332783/SI2.656985

Covering the reporting period from

18/07/2013 to 17/02/2015

Reporting Date

28/02/2015

Project coordinator: Dr. Ragnheidur Thorarinsdottir

WP3-leader: Dr. Paul Kledal

Project website: http://aquaponics.is/ecoponics/

Decision on technology and system choice

For IGFF it was important that its aquaponic production system was a solution to various constraints already existing within present day aquaponics.

This goes in regards to:

- Aquaponics cannot acquire an organic certification
- Due to combining two production systems fixed costs are high compared to investments in either aqua- or horticulture production
- Often high labor costs as a trade-off to high fixed cost in modern technology equipment
- Higher risks due to the dependency among the fish and horticulture production

The IGFF aquaponic test system has addressed these constraints by innovating a system that:

1) Introduces soil to the aquaponic system. To make this feasible the horticulture production is done on plant mobile tables where pots with soil are growing. The plants are then fed by applying the fish nutrients using ‘flood and ebb’ twice a day. The mobile tables are in the same time the most applied system in Danish Horticulture, hence making it more feasible to introduce aquaponics to the existing commercial oriented horticultural sector. By introducing soil into the IGFF aquaponic system the horticultural production is now eligible for organic certification. The fish can due to present EU organic law prohibiting recirculating aquaculture systems only be sold organic if they are sold as fingerlings for growing up in open ponds certified as organic.
2) The fish tanks are placed under the mobile plant tables so ‘economies of space’ are introduced saving a large amount of money on fixed costs since the fish production will only occupy are limited amount of extra greenhouse space.
3) Is applying modern industrial technology equipment in both the aqua- horticulture section hence move aquaponics forward lowering the high labor cost normally following traditional small-scale aquaponic systems. The next challenge is to move beyond the threshold of finding a market demand that can lower the risk of investing in modern industrial labor saving technologies, and make the existing test plant of IGFF and interesting showcase for up-scaling aquaponics
4) IGFF has introduced two loops in its aquaponic production system so they can run independently if a biological failure should occur in either the fish or plant production. Hence the dependency risk normally inherent within aquaponics has been removed.

Figure 1. Special legs invented to secure mobility of the plant tables above the fish tanks, and so secure high savings on space and fixed cost.

Decision on production site

IGFF is introducing aquaponic production in relation to urban or peri-urban farming, and has so far targeted the urban roof-tops as a potential empty space for this purpose. Agreement was first made with Ballerup municipality back in 2013 who had offered to supply their 800 m^2 flat roof of their library in mid-town. Engineer was paid by Ballerup to make analyses on the strength and weaknesses of the building to carry a 600 m^2 aquaponic production. The costs for securing the building were set to 6-700.000 Euro, and IGFF offered to pay these costs if Ballerup municipality would consider lowering the cost of energy and electricity or free of charge in a period of 3 years. Likewise, they were also asked if it was possible to have the aquaponic production become part of the educational system of the municipality, hence pay IGFF over a three year period for taking part in applied teaching be it in math, physics, biology, social science. Unfortunately, Ballerup municipality did not want to consider any of these proposals, and so it was too risky to establish such a costly production based only on IGFF capital contribution, and unknown market demand.

However, during the negotiations with Ballerup municipality in the autumn of 2013 parallel discussions were made with Copenhagen municipality. They were willing to pay 280.000 Euro to introduce a roof platform to carry an aquaponic roof top farm, which was confirmed at a city council meeting in the beginning of February 2014. A suitable house was found with 1.200 m^2 of flat roof, and engineers paid by the municipality started to analyze the statics of the building and potential costs of making a platform. Unfortunately, the house was not able to carry a platform on the roof, and so a new phase of finding another potential building commenced. Two buildings were found during spring/early summer and negotiations started with the owners if they were interested in having an aquaponic production on their roof. One owner declined while another confirmed their interest in September 2014.

Parallel to this IGFF and the municipality decided to go for a roof-top construction like a table placed outside the building so the weight of the aquaponic production is not placed directly on the house, but the forces are going outside and directly to the ground. Engineers were then asked to design such a construction and analyze the costs. A report on this is to be delivered in March 2015 for further decision on actually starting up, and at what size the aquaponic production should be etc.

Figure 2. Fish being fed applying feed on the 24-hour automatic feeder.

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WP4-leader: Dr. Ragnheidur Thorarinsdottir
Project website: http://aquaponics.is/ecoponics/

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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