AQUA EXCEL 2020

AQUAculture infrastructures for EXCELlence in European fish research towards 2020 — AQUAEXCEL2020

D4.4f Face-to-face training course 6

INRA, CSIC, Wageningen University, University of Stirling, AquaTT

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Executive Summary

Objectives
To educate a new generation of aquaculture researchers and industry stakeholders who focus on sustainable exploitation of their new knowledge, skills and tools to advance an innovative European aquaculture sector. The set-up of the training courses will centre on fostering a culture of cooperation between all parties involved.

Rationale:
To foster and build the human capital of the European aquaculture sector several goals are set by the Strategic Research and Innovation Agenda of EATiP to which AQUAEXCEL[2020] contributes. All AQUAEXCEL[2020] training courses are multi-partner collaborations bringing together unique knowledge, tools and skills to create innovative modules that promote and enable peer-to-peer networking and collaboration. Participative training design ensures exchange and mutual learning between trainers and participants from both academia and industry. New models and partnerships for learning are explored for future recurrence, encouraging career development and innovation in the sector. Access to Research Infrastructures (knowledge, facilities and experience) will add value to the training. The AQUAEXCEL[2020] training courses are state-of-the-art, transferring new knowledge and insights originating from the research and services carried out and created by AQUAEXCEL[2020], and building upon outputs, tools and achievements from FP7-AQUAEXCEL.

Main Results:
The AQUAEXCEL[2020] training course "Fish Nutrition and Feeding" was the sixth and final face-to-face course in the AQUAEXCEL[2020] training course series and was provided by Institut National de la Recherche Agronomique (INRA) UMR1419 NUMEA (Nutrition, Métabolisme, Aquaculture), France with the assistance and expertise of Agencia Estatal Consejo Superior de Investigaciones Cientificas (CSIC) (Spain), Wageningen University (WU) (the Netherlands) and University of Stirling (UoS) (United Kingdom). The objective of the course was to teach participants control of feed intake and muscle growth from a nutritional physiology and metabolism approach with parameters and techniques for measuring dietary impacts and regulation of metabolism by carbohydrates, lipids, protein and micronutrients. The course also addressed the interaction of nutrition with genetics, anti-oxidative functions, diet composition and microbial functions, feed production technology, waste production and the use of alternative feed ingredients.

This AQUAEXCEL[2020] training course took place in November 2019 with 30 participants attending, who were selected based on their submitted applications. The course included lectures, practical exercises, a field trip and a mini industry seminar. The mini industry seminar gave the participants the opportunity to exchange with industry professionals in the fish nutrition and feeding field.

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Contents

Introduction

AQUAEXCEL2020 aims to foster a culture of cooperation between European aquaculture Research Infrastructures (RIs), the associated research community, the aquaculture industry and other relevant stakeholders, which will help develop a more efficient and attractive European aquaculture Research Area leading to a sustainable and globally competitive European aquaculture sector. One of AQUAEXCEL2020's specific aims is to provide state-of-the-art unique training courses to educate a new generation of aquaculture researchers and industry stakeholders who focus on sustainable exploitation of their new knowledge, skills and tools to advance an innovative European aquaculture sector. Work package 4 of AQUAEXCEL2020 has a dedicated task focused on training a new generation of aquaculture researchers and industry stakeholders.

Nine technical training courses in total are organised by different AQUAEXCEL2020 partners offered to people within and outside the partnership. The courses focus on different aspects of aquaculture experimentation to foster a culture of cooperation between all parties involved. These training sessions aim to transfer new knowledge and insights originating from the research and services carried out and created by AQUAEXCEL2020.

This AQUAEXCEL2020 training course, which was titled "Fish Nutrition and Feeding", was a five-day face-to-face course. The key learning outcomes for the course were:

- To gain solid knowledge on fish nutrition physiology
- To become aware of raw materials used or going to be used in future aquafeeds
- To understand the basis of fish feed formulation
- To discover fish feed production technology
- To be informed of ongoing research implemented to increase adaptation of fish to new diets devoid of fishmeal and fish oil

This course provided participants with information on topics such as the raw materials used or going to be used in future aquafeeds, how to formulate aquafeeds, the main technologies used for aquafeed production and the current research topics on fish nutrition. Through these topics, this training course helped participants to gain solid knowledge on fish nutrition, physiology and feeding. This course addressed macro- and micro-nutrients and energy requirements, the evaluation of feedstuff and diet digestibility, the link between feed intake and growth as well as feed formulation and production technology. This training course also addressed the environmental impact of aquaculture and feed production, interaction of nutrition with genetics, ongoing research on fish nutrition and feeding and the use of alternative feed ingredients.

Several tutors from INRA contributed to this training course (Sandrine Skiba, Joël Aubin, Aurélie Wilfart, Mathilde Dupont-Nivet, Stéphane Panserat, Iban Seiliez, Florian Beaumatin, Stéphanie Fontagné-Dicharry, Frédéric Terrier, Peyo Aguirre, Franck Sandrès, Anthony Lanuque). There were also tutors from University of Stirling (Brett Glencross), Wageningen

University (Johan Schrama), CSIC (Jaume Perez-Sanchez), Nutricia (Fanny Rochon), Valentin Deporte (Aqualia), Maxime Baptistan (Protifly), Frédéric Cachelou (Viviers de Sarrance) and Nadège Richard (Phileo by Lesaffre).

These leading experts in fish nutrition and feeding presented on:

- Fish physiology
- Research
- Feeding
- Ingredients
- Digestibility
- Formulation
- Extrusion
- Nutrition requirements

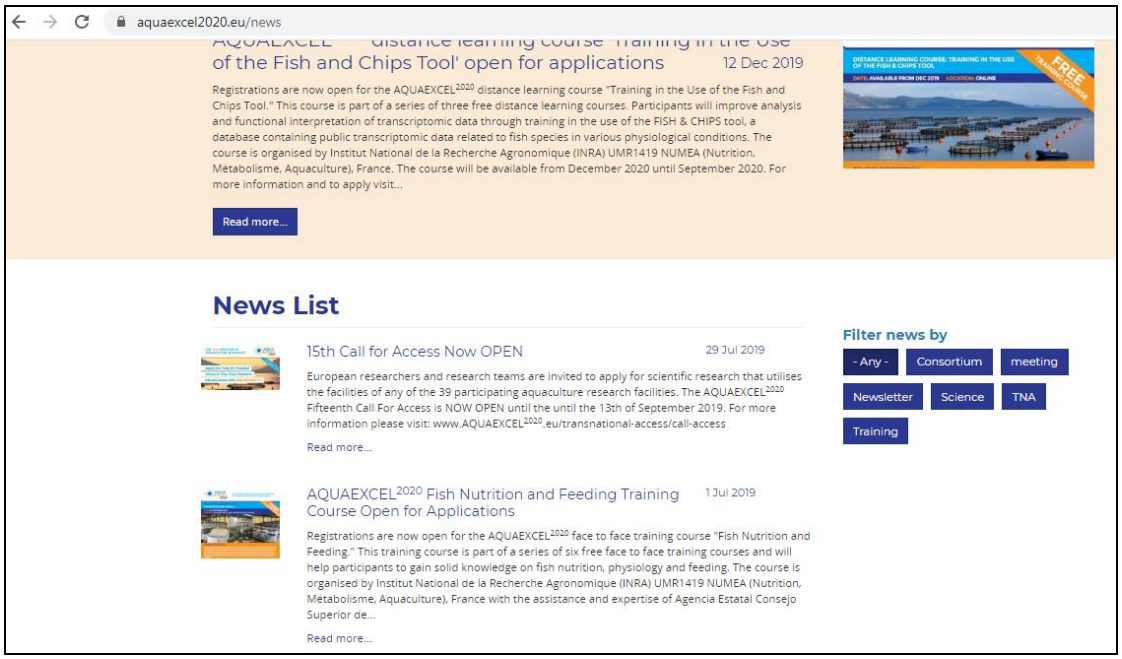
The course included lectures and practical design exercises, along with a field trip and a mini industry seminar. This mini seminar focused on a look into the ingredients of past, present and future. Speakers discussed what they use and why, what they really know about ingredients and what should we be seeking to know and how can we assess that. A number of experts from the industry presented 10 minutes sessions on their opinion of the future of fish nutrition. The seminar also gave the course participants an opportunity to exchange with industry professionals during a 90-minute engagement session.

1. Face-to-face course 6

1.1 Pre-course activities

AquaTT developed a promotional leaflet to promote the Training Course “Fish Nutrition and Feeding” and the course announcement was distributed through several channels such as the AquaTT aquaculture mailing lists, the European Aquaculture Society (EAS) distribution channels, Federation of European Aquaculture Producers (FEAP) and European Aquaculture Technology and Innovation Platform (EATiP) distribution channels, EuroMarine (the European marine science network), the project website (Figure 2), the project Twitter account and the partners’ channels. Annex I shows the promotional leaflet.

Figure 1: Promotional leaflet for AQUAEXCEL2020 Fish Nutrition and Feeding training course



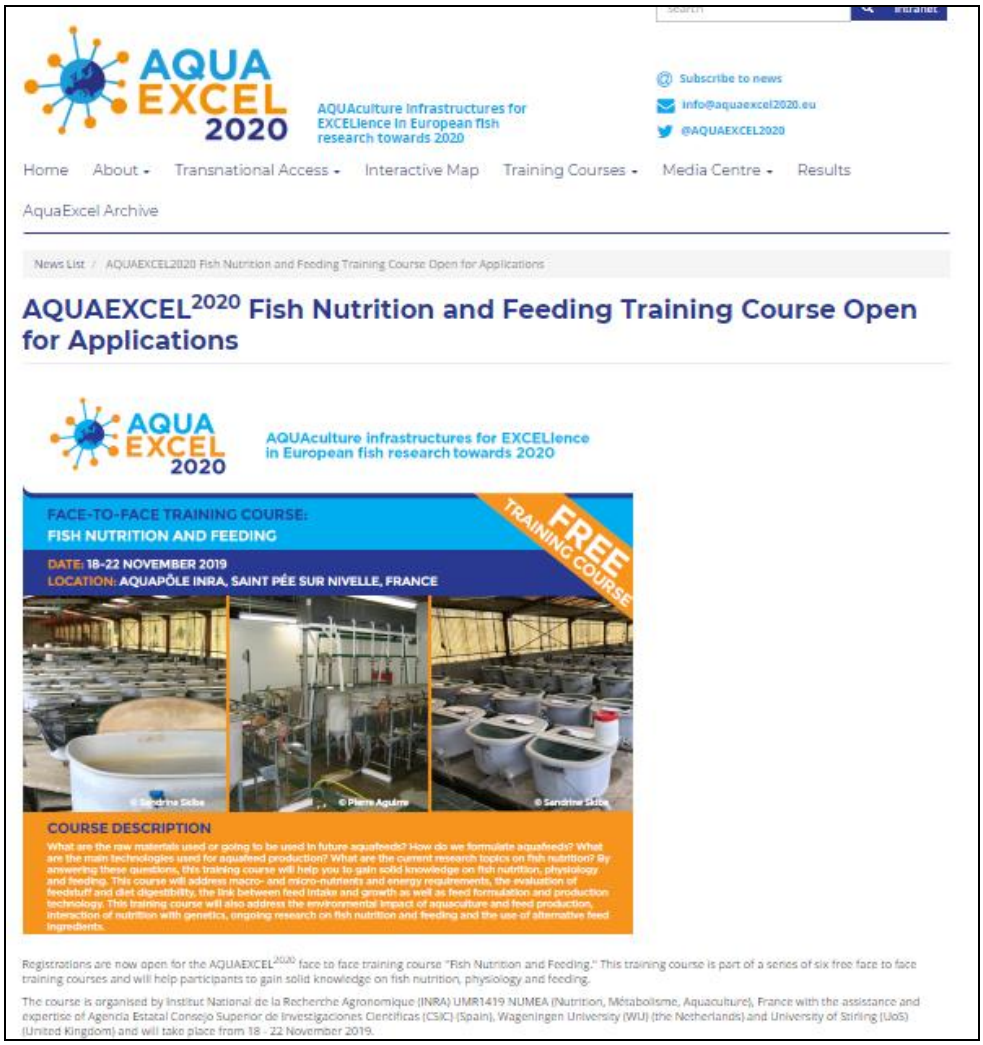


Figure 2: Screenshots of website promotion and application details for Fish Nutrition and Feeding course- https://aquaexcel2020.eu/training-courses/upcoming-training-courses-apply-now

The application period of the course was open from 1 July until 29 July 2019 and applicants were required to complete a registration form (Annex 2) and a letter of motivation and email both together with their CV to aquaexcel@aquatt.ie.

This course was designed for professionals from the fish feed industry who were interested in updating their knowledge on fish nutrition and new aquafeeds formulation. Students interested in specialising in fish nutrition were also encouraged to apply for this course. The course was also open to companies producing new feed ingredients (insect, micro and macroalgae, pre or probiotics) who would like to discover opportunities to enlarge their market to the fish feed production sector.

81 individuals in total applied to participate in this training course, while the maximum number of participants possible was 30. A selection procedure to create a shortlist was put in place by INRA to evaluate applicants based on their CVs and motivation letters. The training programme from the AQUAEXCEL2020 project is set up to improve the research capacity across Europe. The programme is targeted at training a new generation of aquaculture researchers and industry representatives working in the field in one of the EU member states

or new members and associated states of the enlarged EU, facilitating access with special focus on young researchers. Based on this, participants were selected based on the criteria: focus on candidates based in EU and new member states but with the option of including a few non-EU candidates where increased collaborations could be of benefit to Europe, and professionals and scientists working in the fish nutrition and feed field with the ability to contribute to improving this industry across Europe.

1.2 Course activities

30 participants attended the fish nutrition and feeding training course. The activities during the training course are presented in detail in the course agenda in Annex 3 and course tutors and their contact details are listed in Annex 4. During the training course, theoretical lectures were interspersed with practical assignments and technical field trips. In that way, scientific concepts could be verified by the course participants and put into a practical context enabling participants to "learn-by-doing". Higher cognitive levels of learning were gained in discussions throughout the course as well as during the industry mini seminar.

The training as well as the seminar provided good interaction with top specialists, who had innovative examples and are active in the field of fish nutrition and feed (see participant list of industry seminar in Annex 6).

Training material was shared with the participants by the course tutors by email or USB key.

On the first day of the training course the morning sessions focused on macronutrients and micronutrients. The afternoon included a visit of INRA digestibility facilities. This was followed by lectures on raw materials and nutrient digestibility. The final session consisted of a practical exercise using real data to determine the digestibility of diets and individual ingredients.

Day two began with lectures on energy evaluation of fish feed, feed intake – the main driver of growth and why diet specifications vary with fish size. This was followed by the basics of formulation and a practical exercise: formulating a diet for a research purpose.

The third day began with a lecture on the relationship between nutrition and waste production in aquaculture. This was followed by an overview of the application of Life Cycle Assessment for the environmental assessment of aquaculture, with a special focus on aquafeed impacts. The following lectures focused on ecoformulation of diets, ongoing research in sea bream nutrition and selection on growth and a lecture titled "Towards a reliable healthy phenotype." The afternoon lectures covered 'when genetics meets nutrition' to enhance dietary transitions in fish, nutritional programming: a new strategy to improve fish nutrition, fish cell culture, and an innovative approach to decipher molecular mechanisms related to nutritional regulations and MicroRNAs as future non-invasive biomarkers in fish nutrition.

The fourth day focused on technical visits. In the morning, the group visited the experimental INRA fish farm facilities. The INRA fish farm facilities include tanks in a raceway system adapted to the implementation of growth and metabolism trials. The fish farm also hosts experimental facilities for the production of experimental extruded feed. In the afternoon, the group visited Aqualia- a feed factory exclusively dedicated to the aquaculture sector.

The final day of the training course was dedicated to the mini industry seminar. This began with a half hour session discussing:

- The ingredients of past, present and future.
- What do we use and why?
- What do we really know about ingredients?
- What should be seeking to know and how can we assess that?

The next session consisted of 10-minute opinion pieces from aquaculture stakeholders on the future of fish nutrition. These stakeholders included:

- Aquafeed production (Aqualia/Aqualandes)
- Insect production (Protifly)
- Yeast production (Phileo)
- Fish farmer (Viviers de Sarrance)

There was then a 90-minute interactive discussion between participants/stakeholders/scientists which gave the course participants a great opportunity to learn from experts in the field of fish nutrition and feeding.

Figure 3: Participants of the AQUAEXCEL2020 Fish Nutrition and Feeding training course.

Figure 4: Participants of the AQUAEXCEL2020 Fish Nutrition and Feeding training course attending the mini industry seminar.

1.3 Post-course activities

After completion of the course, participants were asked for feedback via an online survey (Figure 5), of which the results are given in Annex 7. These results will help the training course organisers to improve future AQUAEXCEL2020 and AQUAEXCEL3 training courses, and evaluate the need for future fish nutrition and feeding courses. The results of this evaluation exercise were confidential and anonymous so participants could be honest in their comments. The survey was online and took about 15 minutes to complete.

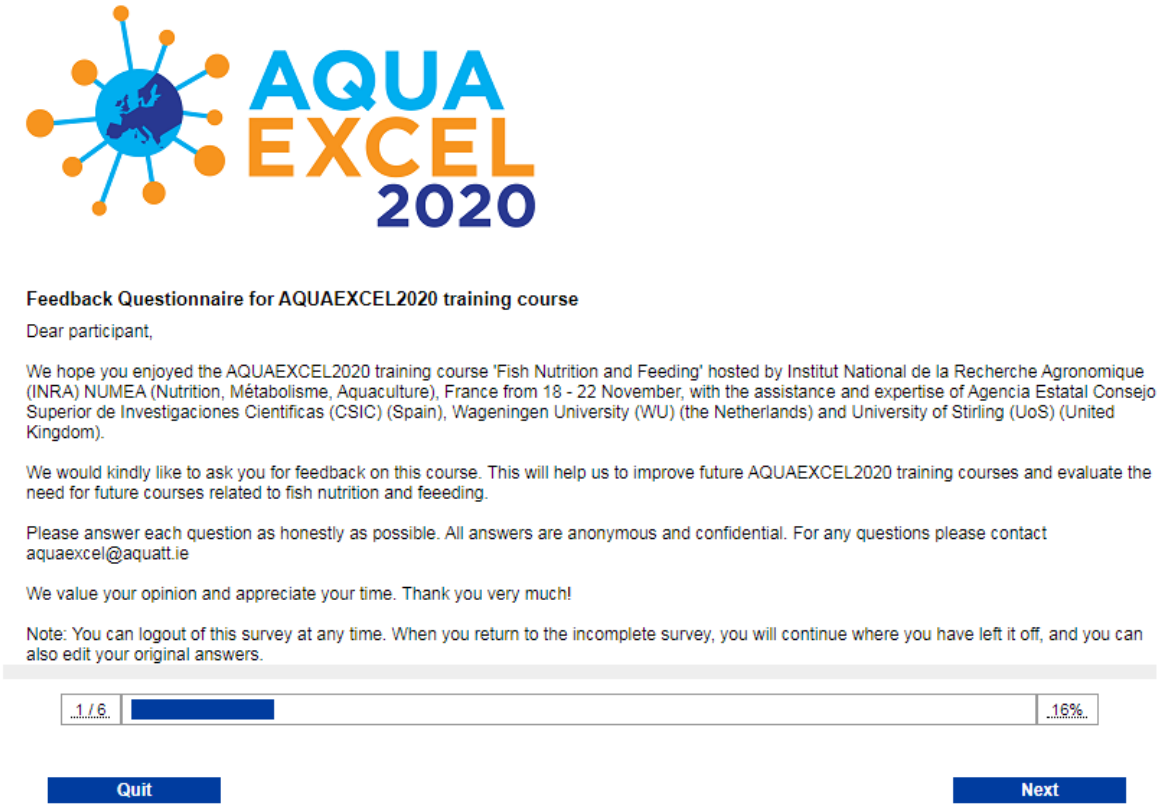


Figure 5: Print screen of welcome page of the online evaluation survey.

Participants were given a certificate of participation if requested, upon completion of the course (Annex 8). Training material was also made available to participants after the course through a USB key containing all the supporting documents.

AquaTT organised pre- and post-course activities, such as finalising course design, developing promotional leaflets and practical information documents, assisting in the organisation, managing the registrations, publishing and promoting the training courses, as well as carrying out and analysing the evaluations. AquaTT also developed the deliverable report.

2. Conclusions

Most survey respondents heard about the course through the AQUAEXCEL2020 website (40%) or through colleagues (40%). The remaining respondents heard about the course through an internet search (13%) or from the EAS website (7%). The online feedback survey had 20 respondents, and all results are included in Annex 7.

40% of respondents were funded through their employer, 33% received project/grant funding and 27% were either fully or partially self-funded.

The training course achieved its desired objectives of training participants in fish nutrition and feeding. This is evident as the percentage of respondents with detailed knowledge of fish nutrition and feeding increased from 20% to 40% and the percentage with expert knowledge increased from 7% to 13%. The number of participants with moderate knowledge increased from 13% to 47%. Before the course, 60% of respondents reported that they only had basic knowledge of fish nutrition and feeding. After the course this decreased to 0%.

The respondents' feedback showed very positive results of the course. 93% agreed or strongly agreed that the duration of the course was good, that the procedure for registration was clear and simple, and that the information leaflet about the course was informative and visually attractive. 73% agreed or strongly agreed that the communication of the course (programme, announcements) was good and 93% agreed that the information at the start of the course was clear. The main conclusion from this feedback is that future AQUAEXCEL2020 and AQUAEXCEL3 training courses should follow the steps taken for the fish nutrition and feeding course in terms of registration, course duration, promotional leaflet and communication.

The training course achieved a very successful grade from the respondents, with 40% awarding it the highest grade (excellent) and 50% awarding it a grade of good. No participants rated the course poor or below average.

Some examples of reasons for the grades were:

- *"Organizer did their best to organize course where everything went smoothly. The choice of lecturers was excellent. The presented topics are current and participants got a chance to hear about current trends in aquaculture. Also, each of the lecturers was open for questions and discussion regarding topics of the course."*
- *"The whole content of the training was presented in a way so that participants without particular knowledge could follow, but a lot of details were still provided and all questions were answered in a satisfying way."*
- *"This was a comprehensive course that catered for a range levels, the content covered in a relative short period of time was excellent."*

Respondents were also very positive about the mini industry seminar. 80% reported that it was either a good or excellent opportunity to exchange with industry professionals. This emphasises the importance of including a mini industry seminar in all AQUAEXCEL2020 training courses and the value participants place on this aspect of the course.

When deciding to enrol for the training course, 100% respondents valued course content as a very or extremely important factor. 73% valued the course trainers as a very or extremely important factor, 67% valued the course as free to enrol as a very or extremely important factor and 60% valued the course organisers as very or extremely important.

The best things about the training course which were mentioned by participants in the survey included:

- *"Organization"*
- *"Speakers and content"*
- *"Visiting the installations"*
- *"Everything was on time and up to schedule. The organizers were excellent hosts."*
- *"The very experienced lecturers"*

Areas were there were suggestions for improvement for future AQUAEXCEL2020 training courses included:

- *"I personally prefer to have lecture slides provided beforehand so that I do not have to write everything down."*
- *"The place is difficult to arrive, but I am not sure if this could be improved."*

For future fish nutrition and feeding training courses participants suggested the following topics:

- Deep information about feed additives and innovation on feed additives
- Larval nutrition
- Some basic information on fish feed production process and influence of raw materials on production processing and quality of final feed

The overall results from the online survey show that the vast majority of participants were very satisfied with their experience and increased their knowledge of fish nutrition and feeding. 80% of respondents indicated that they would or may be interested in attending a follow-up course. 90% said that they would recommend this course to a fellow student/colleague. The survey results demonstrate how worthwhile and beneficial the participants found the course and how it has successfully increased fish nutrition and feeding knowledge in the aquaculture industry.

Glossary

AQUAEXCEL^{2020}: AQUAculture Infrastructures for EXCELlence in European Fish Research towards 2020

UoS: University of Stirling

CSIC: Agencia Estatal Consejo Superior de Investigaciones Cientificas

INRA: French National Institute for Agricultural Research

EAS: European Aquaculture Society

FEAP: Federation of European Aquaculture Producers

EATiP: European Aquaculture Technology and Innovation Platform

WU: Wageningen University

Document information

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Project website	www.aquaexcel2020.eu		

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Date of delivery	**Contractual**	03/2019 (Month 42)	**Actual**	11/2019 (Month 50)
Dissemination level	x	**PU Public, fully open, e.g. web**		
		CO Confidential, restricted under conditions set out in Model Grant Agreement		
		CI Classified, information as referred to in Commission Decision 2001/844/EC.		

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Version log			
Issue Date	**Revision N°**	**Author**	**Change**

Annex 1: Promotional Leaflet

AQUA EXCEL 2020

AQUAculture Infrastructures for EXCELlence in European fish research towards 2020

FACE-TO-FACE TRAINING COURSE:
FISH NUTRITION AND FEEDING

FREE TRAINING COURSE

DATE: 18-22 NOVEMBER 2019
LOCATION: AQUAPÔLE INRA, SAINT PÉE SUR NIVELLE, FRANCE

TARGET AUDIENCE

This course is designed for professionals from the fish feed industry who are interested in updating their knowledge on fish nutrition and new aquafeeds formulation. Students who are interested in specialising in fish nutrition are also welcome on this course. The course is also open to companies producing new feed ingredients (insect, micro and macroalgae, pre or probiotics) who would like to discover opportunities to enlarge their market to the fish feed production sector.

COURSE ORGANISERS

Institut National de la Recherche Agronomique (INRA) UMR1419 NUMEA (Nutrition, Métabolisme, Aquaculture), France with the assistance and expertise of Agencia Estatal Consejo Superior de Investigaciones Cientificas (CSIC) (Spain), Wageningen University (WU) (the Netherlands) and University of Stirling (UoS) (United Kingdom).

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PRACTICAL INFORMATION

Location: INRA Aquapôle, Saint Pée sur Nivelle, France
Date: Monday 18 (09:00hrs) to Friday 22 (12:00hrs) November 2019
Application deadline: 29 July 2019
Language of instruction & material: English
Fees: Course attendance is free, thanks to European Union Horizon 2020 funding. Participants are expected to pay for their own travel, subsistence and accommodation.
Maximum Participants: 30

REGISTRATION

Official registration forms and additional course information can be found on the AQUAEXCEL2020 website at: https://aquaexcel2020.eu/training-courses/upcoming-training-courses-apply-now

Note: Please do not make travel arrangements unless you have received official confirmation of selection.

@aquaexcel2020
www.aquaexcel2020.eu

Annex 2: Application form for training course

AQUAculture infrastructures for EXCELlence in European fish research towards 2020

Registration Form for AQUAEXCEL2020 Face-to-Face Training Course

Course Title: FISH NUTRITION AND FEEDING

Organiser(s): Institut National de la Recherche Agronomique (INRA) UMR1419 NUMEA (Nutrition, Métabolisme, Aquaculture), France with the assistance and expertise of Agencia Estatal Conseio Superior de Investigaciones Cientificas (CSIC) (Spain), Wageningen University (WU) (the Netherlands) and University of Stirling (UoS) (United Kingdom).

Dates: 18 – 22 November 2019

Location: Aquapôle INRA, Saint Pée sur Nivelle, France

Course attendance is free, thanks to EC H2020 funding. Participants are expected to pay for their own travel, subsistence and accommodation. Places will be confirmed, at the latest, two months before the start of the training course. Admittance to the course will be confirmed officially through e-mail. **Please do not make travel arrangements unless you have received official confirmation.**

To submit your registration request, please send the following

- **Completed Registration Form**
- **CV / Résumé**
- **Letter of Motivation**
- **Completed and signed GDPR Consent From**

to aquaexcel@aquatt.ie, with the following subject line: **AQUAEXCEL2020/ TrainingCourse_Nutrition_INRA** by the **29th of July 2019.**

Any questions about the course or application process should be sent to aquaexcel@aquatt.ie

We look forward to welcoming you to the course.

Contact details

Title:	
Surname:	
First Name(s):	
Email:	
Telephone:	
Date of Birth:	
Gender:	

AQUAculture infrastructures for EXCELlence in European fish research towards 2020

Relevant information

Organisation Name:	
Organisation Type: • University • Research Institute • SME • Private Company • Other (please specify)	
Country:	
Position:	

Highest Qualification: • PhD • DVM or equivalent • MSc or equivalent • BSc or equivalent • Other (please specify)	
Research Category: • Postgraduate • Postdoctoral • Expert • Technician • Other (please specify)	
Previous Relevant Experience:	
Additional Support:	

Please complete all sections of this form and email it to: aquaexcel@aquatt.ie, with a CV, letter of motivation and completed and signed GDPR form, indicating in subject: AQUAEXCEL2020 /TrainingCourse_Nutrition_INRA by the 29th of July 2019.

Annex 3: Course Agenda

AQUA EXCEL 2020	AquaExcel Nutrition Training Course Aquapôle INRA Saint Pée sur Nivelle, November, 18 – 22, 2019

Monday

09:00 11:00	*Macronutrients – The foundations of nutrition*	BG	A review of the requirements by a range of species for the key macronutrients of protein (amino acids), lipids (essential fatty acids) and energy from macronutrients.
11:00 11:15	**Coffee break**		
11:15 12:15	*Micronutrients – The fine-tuning of nutrition*	BG/SF	A review of the requirements by a range of species for the key micronutrients of vitamins and minerals.
Lunch			
13:30 15:00	*Visit of INRA digestibility facilities*	PA/CB	Feces collector + proximate analysis laboratory
15:00 16:00	*Raw Materials – Supplying Nutrients*	BG	A review of the application of a range of common protein and lipid based raw materials across species, including an overview SWOT analysis.
16:00 16:15	**Coffee break**		
16:15 17:15	*Nutrient digestibility – sources of variability*	JS	A review of: basic digestive physiology, methods to measure digestibility and an overview of factors affecting digestion.
17:15- 18:15	*Calculating Digestibility*	BG+JS	An exercise using real data to determine the digestibility of diets and individual ingredients.

Tuesday

09:00 10:00	*Energy evaluation of fish feed*	JS	A review of the principles of energy utilization by fish, addressing current and potential future evaluation systems and highlighting variability between fish species.
10:00 11:00	*Feed intake – the main driver of growth*	JS	A review addressing the major fish, diet and environmental factors that determine feed intake.
11:00 11:15	**Coffee break**		
11:15 12:15	*Why diet specifications vary with fish size?*	BG	A review of the basis for varying the DP:DE ratios of diets and how we define

			this and this implications for diet formulation.
Lunch			
13:30 14:30	*Formulation : basics*	CB/FR	A review addressing the main steps of the formulation process of aquafeeds
15:00 16:30	*Diet for research - Exercise*	CB	Practical exercise: formulation of a diet for research purpose
16:30 16:45	**Coffee break**		
16:45 18:15	*Diet for farmers - Exercise*	CB/FR	Practical exercise: formulation of a diet for research purpose

Wednesday

09:00 10:00	*The relation between nutrition and waste production in aquaculture*	JS	An overview of dietary factors that determine waste production in aquaculture, addressing aspects of amount, composition and characteristics of waste and the impact of waste in RAS.
10:00 11:00	*LCA applied to aquaculture*	JA	An overview of the application of Life Cycle Assessment for the environmental assessment of aquaculture, with a special focus on aquafeed impacts.
11:00 11:15	**Coffee break**		
11:15 12:15	*Ecoformulation of diets*	AW	An overview of a method to integrate both environmental and economic criteria in the formulation of feeds. Presentation of the multi-objective method of feed formulation and the potential gain in regards of environmental impacts of feeds
Lunch			
13:30 14:30	*Ongoing research in sea bream nutrition and selection on growth*	JPS	Plant-based diets with less than 10% marine ingredients support maximum growth in sea bream through the production cycle. Improved genetic growth is associated with less growth seasonality and a high phenotypic intestine flexibility, but without apparent genotype by diet interactions on growth performance.
14:30 15:30	*Towards a reliable healthy phenotype*	JPS	Wide-omic approaches, including transcriptomics, proteomics, metabolomics and metagenomics, contribute to establish stricter criteria of growth performance and welfare in marine farmed fish. Changes in these omics features are related to different drawback effects, and the restoration of the wild phenotype by feed additives is both of diagnostic and prognostic value in

			farmed sea bream facing different aquaculture stressors.
15:30 16:00	*When genetics meets nutrition to enhance dietary transitions in fish*	MDN	When facing very high substitution rates, performances decreases are observed in Rainbow trout. However, high genetic variability for ability to grow and survive with 100 % plant-based diets was evidenced: some genotypes are able to adapt, others are not. Thus genetics can help dietary transition by 1/selecting animals adapted to new diets 2/using genotypes with contrasted performances to understand underlying mechanisms of adaptation.
16:00 16:15	**Coffee break**		
16:15 16:45	*Nutritional programming: a new strategy to improve fish nutrition?*	SP	Nutritional programming is that environmental stimulus exerted at critical developmental stages early in life may have long-term consequences on nutrition later in life. This concept is more and more studied in aquaculture fish in order to improve the use of new aquafeeds.
16:45 17:15	*Fish cell culture, an innovative approach to decipher molecular mechanisms related to nutritional regulations*	IS/FB	Immortal, but also primary cultures of cells can have several advantages over studying complex mechanisms in whole animals, including simplified measurements of function under controlled conditions as well as increased the robustness of data obtained with cells from the same fish, refining experiments and reducing the number of animals sacrificed.
17:15 17:45	*MicroRNAs as future non-invasive biomarkers in fish nutrition?*	SS	MicroRNAs are small non-coding RNA molecules containing about 22 nucleotides. Expressed by tissues they are also found in the blood. In human, circulating micrRNAs are increasingly suggested as biomarkers of diseased or physiopathological conditions. What about using them as non-invasive biomarkers applied to fish nutrition purpose?

Thursday

09:00 12:00	*Experimental INRA fish farm facilities - Visit*	FT/SP/SS	The INRA fish farm facilities include tanks in a raceway system adapted to the implementation of growth and metabolism trials. The fish farm also hosts experimental facilities for the production

			of experimental extruded feed.
Lunch			
14:00 17:00	*Aqualia - Visit*	Aqualia	Visit of a feed factory exclusively dedicated to the aquaculture sector.

Friday **Mini seminar "Fish nutrition and feeding"**

9:00 9:30	*Mini seminar introduction* *Fish nutrition and feeding – introduction on past and future ingredients*	BG/SS	A look into the ingredients of past, present and future. What do we use and why? What do we really know about ingredients? What should be seeking to know and how can we assess that?
09:30- 10:30	*Opinion from aquaculture stakeholders on the future of fish nutrition (10 min each)*		- Aquafeed production (Aqualia/Aqualandes) - Insect production (Protifly) - Yeast production (Phileo) - Farmers (Viviers de Sarrance)
10:30- 12	*Interactive discussion between participants/stakeholders/scientists*	SS/SP	

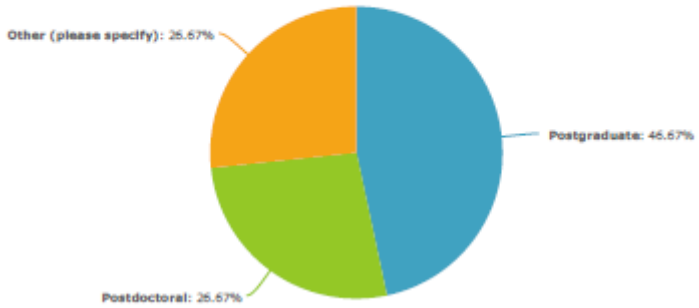
Annex 4: Course Tutors

Annex 5: Participant List: Training Course

Annex 6. Participant list: Industry seminar

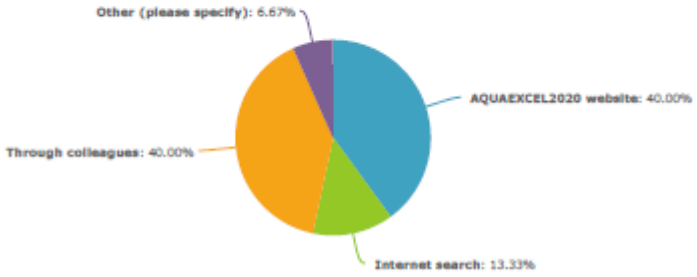
Annex 7. Survey results

1. 1. What is your current research category?



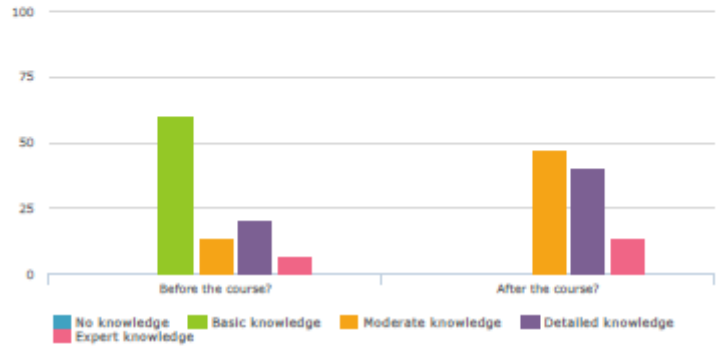
Postgraduate	46.67%		7
Postdoctoral	26.67%		4
Expert	0.00%		0
Technician	0.00%		0
I work for the industry	6.67%		1
Industry Researcher	6.67%		1
Phd	6.67%		1
R&D employee of fish farm company	6.67%		1
		Total Responses	15
		Skipped	5

2. **2. How did you hear about this course?**



AQUAEXCEL2020 website	40.00%		6
Internet search	13.33%		2
Through colleagues	40.00%		6
AQUAEXCEL2020 Twitter	0.00%		0
EAS website	6.67%		1
		Total Responses	15
		Skipped	5

3. **3. How would you rate your knowledge of fish nutrition and feeding:**



	No knowledge	Basic knowledge	Moderate knowledge	Detailed knowledge	Expert knowledge	Responses
Before the course?	**0** 0.00%	**9** 60.00%	**2** 13.33%	**3** 20.00%	**1** 6.67%	15
After the course?	**0** 0.00%	**0** 0.00%	**7** 46.67%	**6** 40.00%	**2** 13.33%	15

Total Responses	15
Skipped	5

4. 4. How important were the following factors for you when

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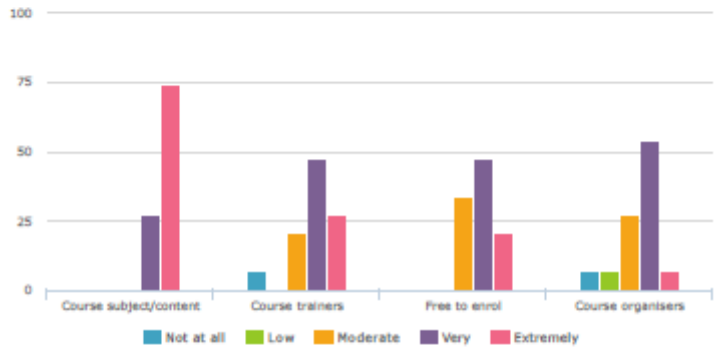
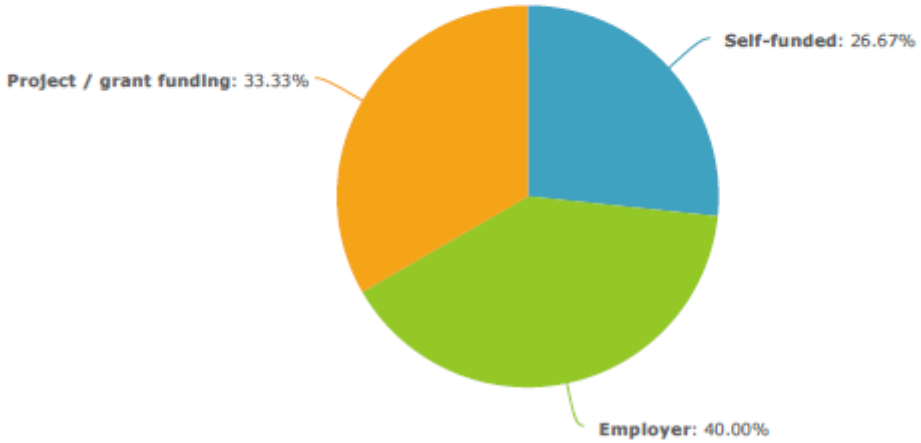
deciding to enrol into this training course?



	Not at all	Low	Moderate	Very	Extremely	Responses
Course subject/content	0 0.00%	0 0.00%	0 0.00%	4 26.67%	11 73.33%	15
Course trainers	1 6.67%	0 0.00%	3 20.00%	7 46.67%	4 26.67%	15
Free to enrol	0 0.00%	0 0.00%	5 33.33%	7 46.67%	3 20.00%	15
Course organisers	1 6.67%	1 6.67%	4 26.67%	8 53.33%	1 6.67%	15

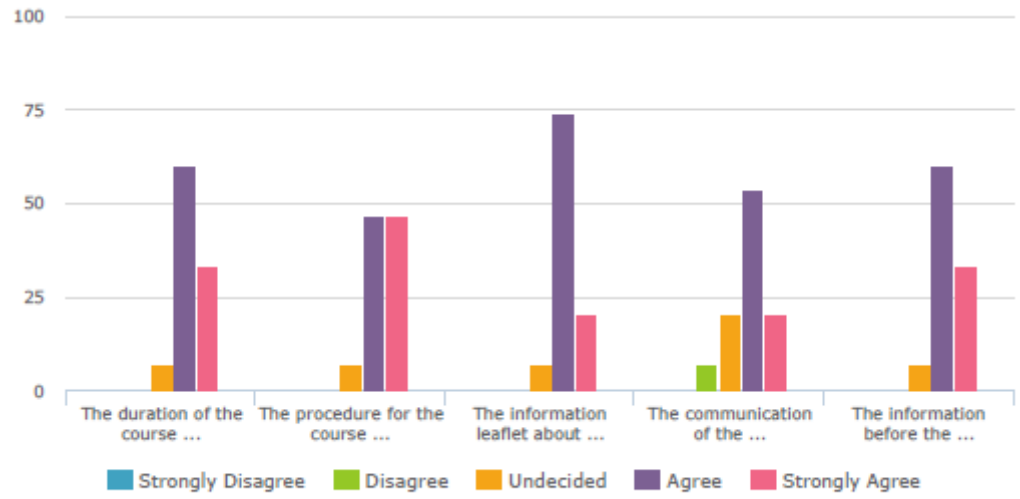
Total Responses	15
Skipped	5

5. **5. How were you funded/how did you fund the travel and subsistence expenses?**



Self-funded	26.67%		4
Employer	40.00%		6
Project / grant funding	33.33%		5
		Total Responses	15
		Skipped	5

6. **6. Please read the following statements and indicate how they correspond to your experience of the course organisation.**



	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Responses
The duration of the course was good.	0 0.00%	0 0.00%	1 6.67%	9 60.00%	5 33.33%	15
The procedure for the course registration was clear and simple.	0 0.00%	0 0.00%	1 6.67%	7 46.67%	7 46.67%	15
The information leaflet about the course was informative and visually attractive.	0 0.00%	0 0.00%	1 6.67%	11 73.33%	3 20.00%	15
The communication of the course (announcements, programme, etc.) was good.	0 0.00%	1 6.67%	3 20.00%	8 53.33%	3 20.00%	15
The information before the start of the course was clear.	0 0.00%	0 0.00%	1 6.67%	9 60.00%	5 33.33%	15

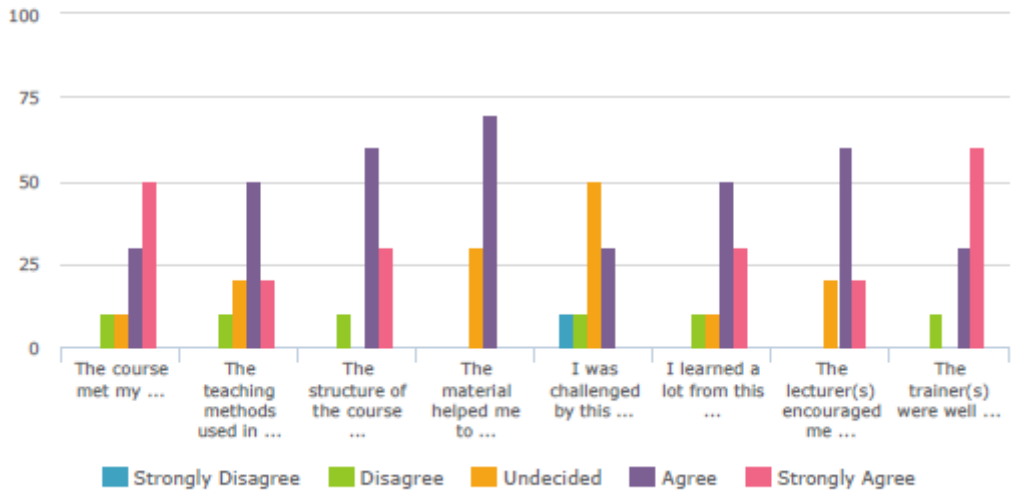
Total Responses	15
Skipped	5

7. 7. Do you have any more feedback on the organisation of the course?

Count	Response
1	- Better/more integration of practical exercises would have been great - Poll/wish list for topics to be covered would be great for the next time - A step-wise manual for the Allix software would have been very useful, but presenting a whole new software tool to a large group with varying knowledge in such a short time is difficult anyway. - I personally would have preferred an introduction in the mathematical background of feed formulation instead of a software tool which might not be affordable for the single participant.
1	Everything was really well organized and we really have a complete course
1	It could be better to get schedule earlier to be able to book flights and trains at the most apropriat time
1	It would be better if the programm of the course was communicate earlier. Wednesday training day was maybe too long.
1	Some topics where not taken in consideration, some topics were repeated and too many hours. better shorter explanations and more topics related to nutrition.
1	The course place was not easy to reach by plane, and there were no public transport! This could have been organise better as a host Institute! Nothing plan for participant for networking after the course! Since the restaurants were mostly close, and without a car it was not easy to reach everywhere, and most people doesnt speak French, it was not possible to meet freely and network more with the participant and course organisers. Practical time for the feed formulation should have been longer! It was a chaos while we were trying the software. Next time, the organisers can prepare print outs with screenshots and steps how to create the formulartion. That would help all of us to follow better.
1	The process overall was clear with appropriate communication

Total Responses	7
Skipped	13

8. **8. Please read the following statements and indicate how they correspond to your experience of the course.**

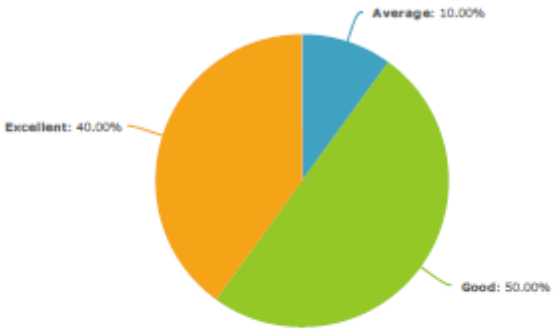


	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Responses
The course met my expectations.	**0** 0.00%	**1** 10.00%	**1** 10.00%	**3** 30.00%	**5** 50.00%	10
The teaching methods used in this course helped me achieve the course's learning outcomes.	**0** 0.00%	**1** 10.00%	**2** 20.00%	**5** 50.00%	**2** 20.00%	10
The structure of the course was logical.	**0** 0.00%	**1** 10.00%	**0** 0.00%	**6** 60.00%	**3** 30.00%	10
The material helped me to master the content.	**0** 0.00%	**0** 0.00%	**3** 30.00%	**7** 70.00%	**0** 0.00%	10
I was challenged by this course.	**1** 10.00%	**1** 10.00%	**5** 50.00%	**3** 30.00%	**0** 0.00%	10

I learned a lot from this course.	**0** 0.00%	**1** 10.00%	**1** 10.00%	**5** 50.00%	**3** 30.00%	10
The lecturer(s) encouraged me to think about the subject matter.	**0** 0.00%	**0** 0.00%	**2** 20.00%	**6** 60.00%	**2** 20.00%	10
The trainer(s) were well prepared and knowledgeable.	**0** 0.00%	**1** 10.00%	**0** 0.00%	**3** 30.00%	**6** 60.00%	10

Total Responses	10
Skipped	10

9. 9. If you look at all aspects of the course, which grade would you award this course?



Poor	0.00%		0
Below Average	0.00%		0
Average	10.00%		1
Good	50.00%		5
Excellent	40.00%		4
		Total Responses	10
		Skipped	10

10. 10. Please comment on the grade you gave the course (question number 9):

1	The whole content of the training was presented in a way so that participants without particular knowledge could follow, but a lot of details were still provided and all questions were answered in a satisfying way.
1	This was a comprehensive course that catered for a range levels, the content covered in a relative short period of time was excellent.

Total Responses	8
Skipped	12

11. 11. The best thing(s) about this course was/were:

Count	Response
1	- Organization - Speakers and content - Visiting the instalations
1	Brett Glencross lectures.
1	Everything was on time and up to schedule. The organizers were excellent hosts.
1	networking and teachers all-round knowledge
1	networks
1	The lecturers from B. Glencross and J. Schrama were excellent.
1	the mix between visit and course. Brett Glencross LCA applied to aquaculture
1	The very experienced lecturers.
1	Trip to the facilities.

Total Responses	9
Skipped	11

12. 12. The thing(s) to be improved was/were:

Count	Response
1	Facilities
1	Formulation lecture! As described above, point 10.
1	Formulation practicals.
1	I personally prefer to have lecture slides provided beforehand so that I do not have to write everything down.
1	practical exercise part on feed formulation. I had more expectations on that part.
1	The course : Formulation: basics and applications. The applications with the software need to be improved.
1	The formulation practice was a good idea, however, it was not always easy for everyone to follow at the same time. Possibly smaller groups would help.
1	The place is difficult to arrive, but I am not sure if this could be improved. Maybe some different dinamics that just only listening, more particiapation of the attendence.

Total Responses	8
Skipped	12

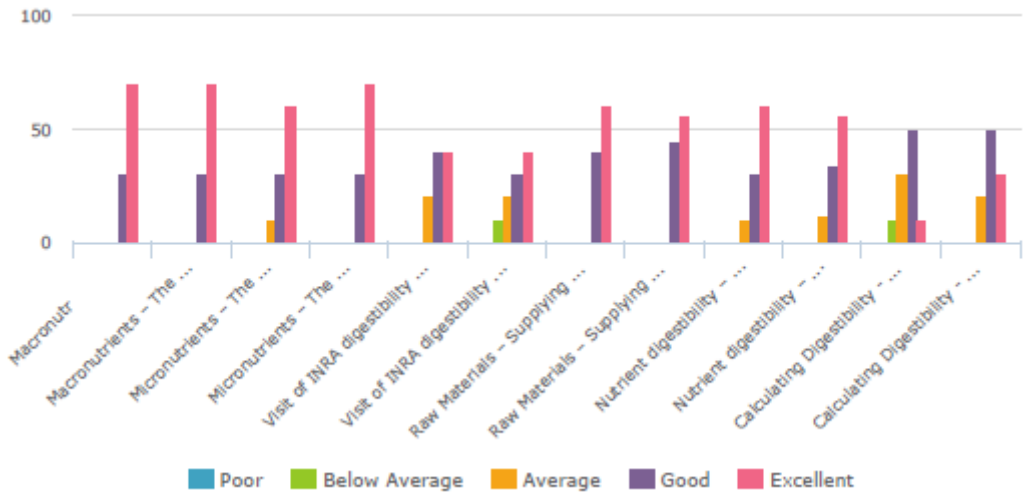
13. 13. Did you miss any subjects/topics?

Please indicate any topics that, in your opinion, should have been included in the course:

Count	Response
1	Deep information about feed additives and innovation on feed additives.
1	I think it was Ok, that topics were perfect.
1	I would have loved to hear about larval nutrition in more detail. It was only a side note during the training.
1	Some basic information on fish feed production process and influence of raw materials on production processing and quality of final feed.
1	Waste production even we are not in RAS

Total Responses	5
Skipped	15

14. **14. How would you rate the quality of the following parts from Day 1?**

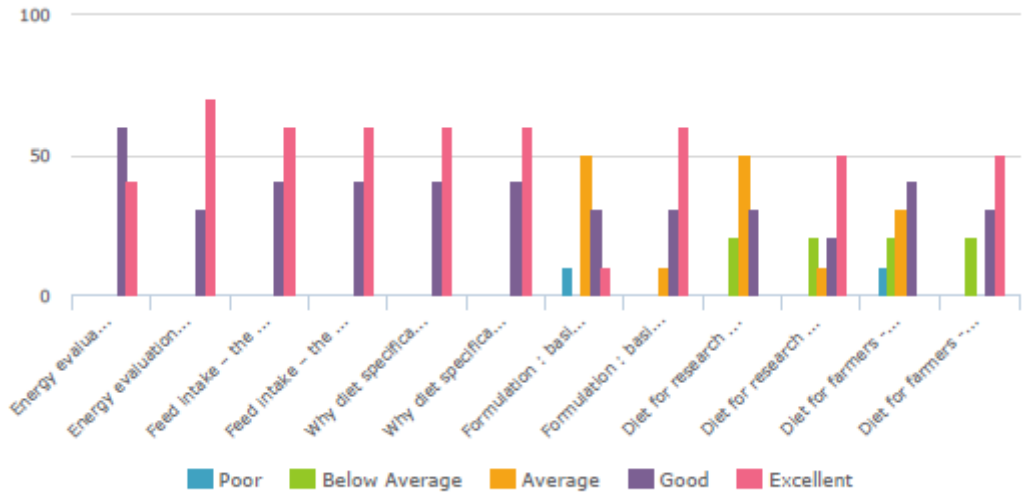


	Poor	Below Average	Average	Good	Excellent	Responses
Macronutrients – The foundations of nutrition - **presentation and materials**	**0** 0.00%	**0** 0.00%	**0** 0.00%	**3** 30.00%	**7** 70.00%	10
Macronutrients – The foundations of nutrition - **relevance**	**0** 0.00%	**0** 0.00%	**0** 0.00%	**3** 30.00%	**7** 70.00%	10
Micronutrients – The fine-tuning of nutrition - **presentation and materials**	**0** 0.00%	**0** 0.00%	**1** 10.00%	**3** 30.00%	**6** 60.00%	10
Micronutrients – The fine-tuning of nutrition - **relevance**	**0** 0.00%	**0** 0.00%	**0** 0.00%	**3** 30.00%	**7** 70.00%	10
Visit of INRA digestibility facilities - **organisation of visit**	**0** 0.00%	**0** 0.00%	**2** 20.00%	**4** 40.00%	**4** 40.00%	10
Visit of INRA digestibility facilities - **relevance**	**0** 0.00%	**1** 10.00%	**2** 20.00%	**3** 30.00%	**4** 40.00%	10
Raw Materials – Supplying Nutrients - **presentation and materials**	**0** 0.00%	**0** 0.00%	**0** 0.00%	**4** 40.00%	**6** 60.00%	10

Raw Materials – Supplying Nutrients - **relevance**	**0** 0.00%	**0** 0.00%	**0** 0.00%	**4** 44.44%	**5** 55.56%	9
Nutrient digestibility – sources of variability - **presentation and materials**	**0** 0.00%	**0** 0.00%	**1** 10.00%	**3** 30.00%	**6** 60.00%	10
Nutrient digestibility – sources of variability - **relevance**	**0** 0.00%	**0** 0.00%	**1** 11.11%	**3** 33.33%	**5** 55.56%	9
Calculating Digestibility - **instruction and materials**	**0** 0.00%	**1** 10.00%	**3** 30.00%	**5** 50.00%	**1** 10.00%	10
Calculating Digestibility - **relevance**	**0** 0.00%	**0** 0.00%	**2** 20.00%	**5** 50.00%	**3** 30.00%	10

Total Responses	10
Skipped	10

15. 15. How would you rate the quality of the following parts from Day 2?



	Poor	Below Average	Average	Good	Excellent	Responses
Energy evaluation of fish feed - **presentation and materials**	**0** 0.00%	**0** 0.00%	**0** 0.00%	**6** 60.00%	**4** 40.00%	10
Energy evaluation of fish feed - **relevance**	**0** 0.00%	**0** 0.00%	**0** 0.00%	**3** 30.00%	**7** 70.00%	10
Feed intake – the main driver of growth - **presentation and materials**	**0** 0.00%	**0** 0.00%	**0** 0.00%	**4** 40.00%	**6** 60.00%	10
Feed intake – the main driver of growth - **relevance**	**0** 0.00%	**0** 0.00%	**0** 0.00%	**4** 40.00%	**6** 60.00%	10
Why diet specifications vary with fish size - **presentation and materials**	**0** 0.00%	**0** 0.00%	**0** 0.00%	**4** 40.00%	**6** 60.00%	10
Why diet specifications vary with fish size - **relevance**	**0** 0.00%	**0** 0.00%	**0** 0.00%	**4** 40.00%	**6** 60.00%	10
Formulation : basics - **presentation and materials**	**1** 10.00%	**0** 0.00%	**5** 50.00%	**3** 30.00%	**1** 10.00%	10
Formulation : basics - **relevance**	**0** 0.00%	**0** 0.00%	**1** 10.00%	**3** 30.00%	**6** 60.00%	10
Diet for research - Exercise - **instruction and materials**	**0** 0.00%	**2** 20.00%	**5** 50.00%	**3** 30.00%	**0** 0.00%	10
Diet for research - Exercise - **relevance**	**0** 0.00%	**2** 20.00%	**1** 10.00%	**2** 20.00%	**5** 50.00%	10
Diet for farmers - Exercise - **instruction and materials**	**1** 10.00%	**2** 20.00%	**3** 30.00%	**4** 40.00%	**0** 0.00%	10
Diet for farmers - Exercise - **relevance**	**0** 0.00%	**2** 20.00%	**0** 0.00%	**3** 30.00%	**5** 50.00%	10

Total Responses	10
Skipped	10

16. **16. How would you rate the quality of the following parts from Day 3?**

	Poor	Below Average	Average	Good	Excellent	Responses
The relationship between nutrition and waste production in aquaculture - **presentation and materials**	**0** 0.00%	**0** 0.00%	**1** 10.00%	**6** 60.00%	**3** 30.00%	10
The relationship between nutrition and waste production in aquaculture - **relevance**	**0** 0.00%	**0** 0.00%	**1** 11.11%	**3** 33.33%	**5** 55.56%	9
LCA applied to aquaculture - **presentation and materials**	**0** 0.00%	**0** 0.00%	**2** 20.00%	**3** 30.00%	**5** 50.00%	10
LCA applied to aquaculture - **relevance**	**0** 0.00%	**0** 0.00%	**2** 20.00%	**3** 30.00%	**5** 50.00%	10
Ecoformulation of diets - **presentation and materials**	**0** 0.00%	**0** 0.00%	**4** 40.00%	**5** 50.00%	**1** 10.00%	10
Ecoformulation of diets - **relevance**	**0** 0.00%	**0** 0.00%	**1** 10.00%	**5** 50.00%	**4** 40.00%	10
Ongoing research in sea bream nutrition and selection on growth - **presentation and materials**	**0** 0.00%	**0** 0.00%	**3** 30.00%	**5** 50.00%	**2** 20.00%	10

Ongoing research in sea bream nutrition and selection on growth - **relevance**	**0** 0.00%	**0** 0.00%	**2** 20.00%	**7** 70.00%	**1** 10.00%	10
Towards a reliable healthy phenotype - **presentation and materials**	**0** 0.00%	**0** 0.00%	**2** 22.22%	**5** 55.56%	**2** 22.22%	9
Towards a reliable healthy phenotype - **relevance**	**0** 0.00%	**1** 10.00%	**1** 10.00%	**7** 70.00%	**1** 10.00%	10
When genetics meets	**0**	**0**	**2**	**4**	**4**	10

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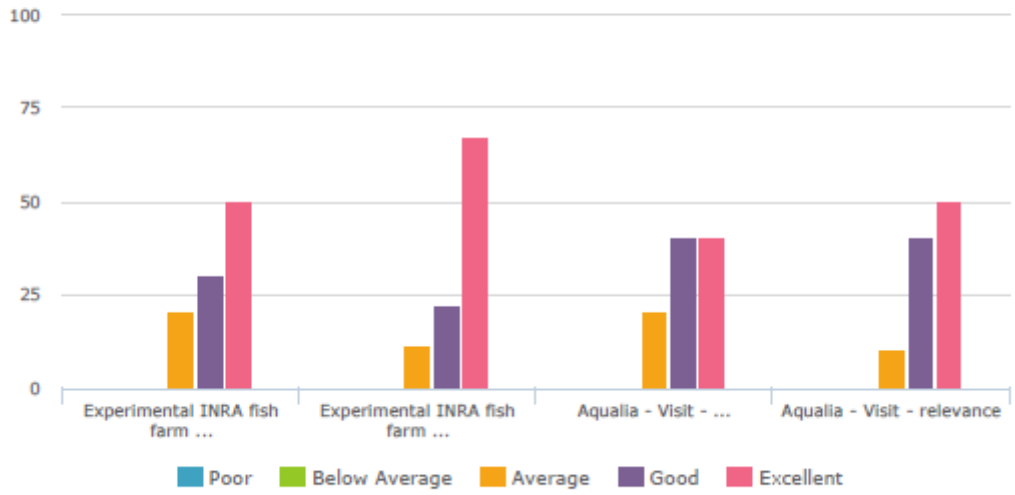
nutrition to enhance dietary transitions in fish - **presentation and materials**	0.00%	0.00%	20.00%	40.00%	40.00%	
When genetics meets nutrition to enhance dietary transitions in fish - **relevance**	**0** 0.00%	**1** 10.00%	**1** 10.00%	**5** 50.00%	**3** 30.00%	10
Nutritional programming: a new strategy to improve fish nutrition - **presentation and materials**	**0** 0.00%	**0** 0.00%	**3** 30.00%	**5** 50.00%	**2** 20.00%	10

Nutritional programming: a new strategy to improve fish nutrition - **relevance**	**0** 0.00%	**0** 0.00%	**1** 11.11%	**7** 77.78%	**1** 11.11%	9
Fish cell culture, an innovative approach to decipher molecular mechanisms related to nutritional regulations - **presentation and materials**	**0** 0.00%	**0** 0.00%	**2** 20.00%	**6** 60.00%	**2** 20.00%	10
Fish cell culture, an innovative approach to decipher molecular mechanisms related to nutritional regulations - **relevance**	**0** 0.00%	**0** 0.00%	**3** 30.00%	**6** 60.00%	**1** 10.00%	10
MicroRNAs as future non-invasive biomarkers in fish nutrition - **presentation and materials**	**0** 0.00%	**0** 0.00%	**1** 11.11%	**6** 66.67%	**2** 22.22%	9
MicroRNAs as future non-invasive biomarkers in fish nutrition - **relevance**	**0** 0.00%	**1** 12.50%	**0** 0.00%	**6** 75.00%	**1** 12.50%	8

Total Responses	10
Skipped	10

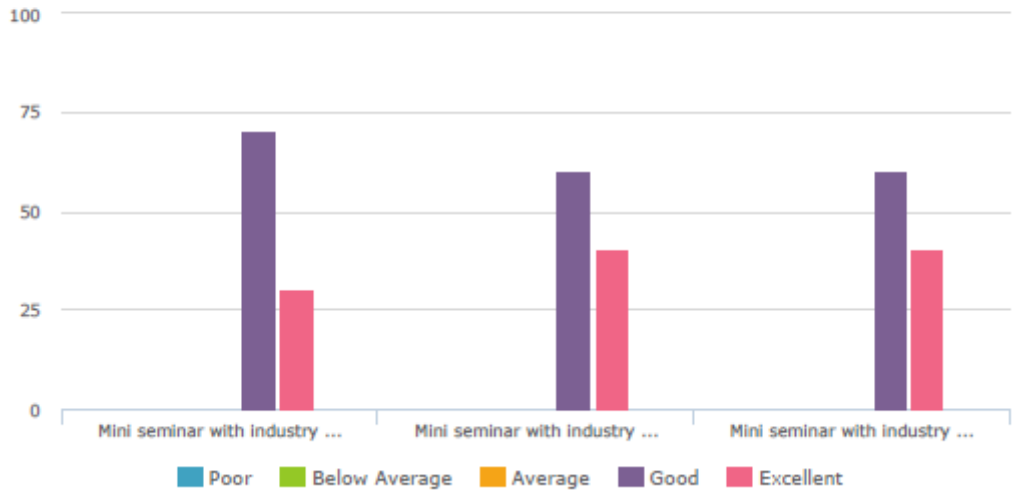
17. **17. How would you rate the quality of the following parts from Day 4?**



	Poor	Below Average	Average	Good	Excellent	Responses
Experimental INRA fish farm facilities - Visit - **organisation of visit**	**0** 0.00%	**0** 0.00%	**2** 20.00%	**3** 30.00%	**5** 50.00%	10
Experimental INRA fish farm facilities - Visit - **relevance**	**0** 0.00%	**0** 0.00%	**1** 11.11%	**2** 22.22%	**6** 66.67%	9
Aqualia - Visit - **organisation of visit**	**0** 0.00%	**0** 0.00%	**2** 20.00%	**4** 40.00%	**4** 40.00%	10
Aqualia - Visit - **relevance**	**0** 0.00%	**0** 0.00%	**1** 10.00%	**4** 40.00%	**5** 50.00%	10

Total Responses	10
Skipped	10

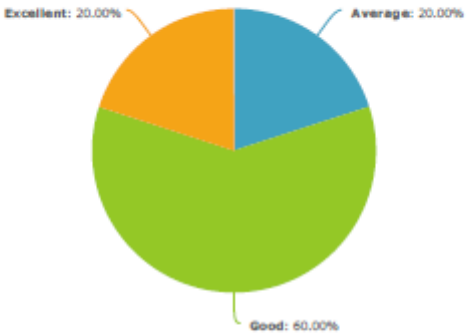
18. 19. How would you rate the quality of the Industry Mini Seminar on Day 5?



	Poor	Below Average	Average	Good	Excellent	Responses
Mini seminar with industry partners - **opportunities for exchange**	**0** 0.00%	**0** 0.00%	**0** 0.00%	**7** 70.00%	**3** 30.00%	10
Mini seminar with industry partners - **representation of industry experts**	**0** 0.00%	**0** 0.00%	**0** 0.00%	**6** 60.00%	**4** 40.00%	10
Mini seminar with industry partners - **concept**	**0** 0.00%	**0** 0.00%	**0** 0.00%	**6** 60.00%	**4** 40.00%	10

Total Responses	10
Skipped	10

19. 20. How beneficial was the opportunity to exchange with industry professionals for you personally during the Industry Seminar on Day 5?



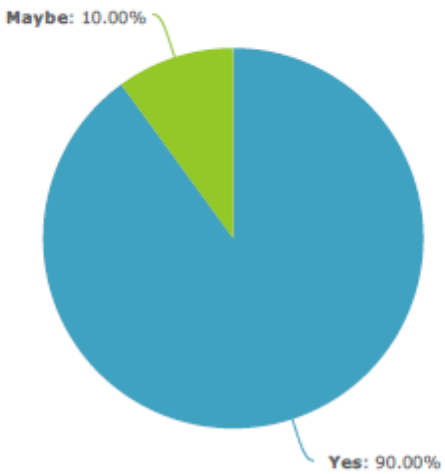
Poor	0.00%		0
Below Average	0.00%		0
Average	20.00%		2
Good	60.00%		6
Excellent	20.00%		2
		Total Responses	10
		Skipped	10

20. **21. Please suggest changes and/or improvements you would like to see made to the trainers' approach to teaching and facilitating:**

Count	Response
1	A complete day for formulation of diets would have been perfect! maybe half day how you do it in Excel without a Software. and next half, how we can do it in a software.
1	I will try to give more time for the debate with the industrial partners and maybe in small groups.
1	I would like to have some interactive approaches in between, e.g. the use of mini-quizzes with kahoot as they improve focus and also facilitate memorising the knowledge provided. Providing the lectures in a digital way afterwards, e.g. by recording them, would also be very helpful as some important aspects or explanations might not be accessible by the lecture slides themselves.
1	improving the exercise on feed formulation
1	Mixing lectures with practical worked well to keep engagement. Would have been helpful to have the presentations beforehand to make notes with the slides.

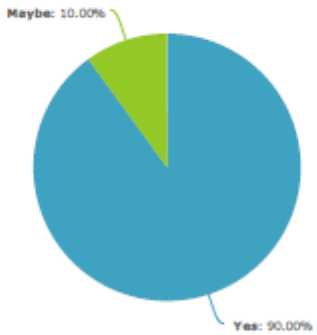
Total Responses	5
Skipped	15

21. **22. Would you like to attend a follow-up course in the future?**



Yes	90.00%		9
No	0.00%		0
Maybe	10.00%		1
		Total Responses	10
		Skipped	10

22. **23. Would you recommend this course to a fellow student/colleague?**



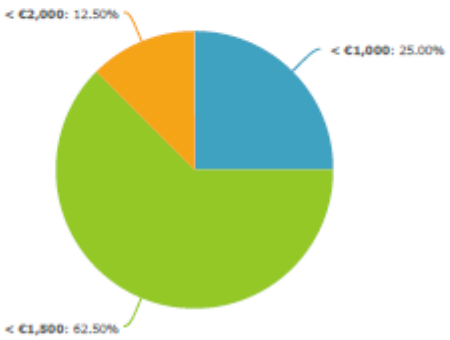
Yes	90.00%		9
No	0.00%		0
Maybe	10.00%		1
		Total Responses	10
		Skipped	10

23. **24. Please describe your learning experience in "Twitter" style (280 characters or less):**

Count	Response
1	Multicultural scene in a rural area has totally sparking my passion for Aquaculture nutrition. We've learned a huge amount of knowledge and had the opportunity of meeting with experts from the sector.
1	Very intense with more and less interesting content, but never being boring. In terms of lectures too much information for one day.

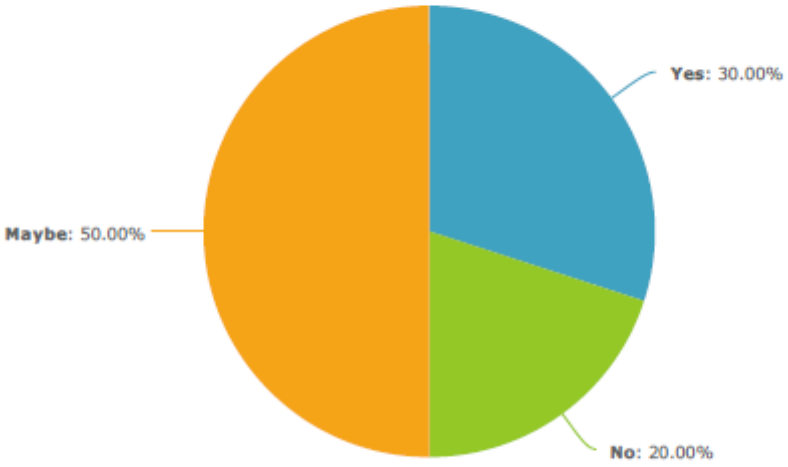
Total Responses	2
Skipped	18

24. 25. The Fish Nutrition and Feeding training course was subsidised. What would be the maximum amount you/your company could afford to pay for a similar course?



< €1,000	25.00%		2
< €1,500	62.50%		5
< €2,000	12.50%		1
< €3,000	0.00%		0
> €3,000	0.00%		0
		Total Responses	8
		Skipped	12

25. **26. Would you or your institute be interested in future Experimental Infection Trials in Fish courses organised by INRA, CSIC, WU and UoS at the cost indicated by you above?**



Yes	30.00%		3
No	20.00%		2
Maybe	50.00%		5
		Total Responses	10
		Skipped	10

26. **27. Do you have any other suggestions or feedback?**

Count	Response

Total Responses	0
Skipped	20

Annex 8: Certificate of Participation

AQUAculture Infrastructures for EXCELlence in European fish research towards 2020

Training Course: Fish Nutrition and Feeding

CERTIFICATE OF PARTICIPATION

This certificate confirms that the following candidate participated in the AQUAEXCEL2020 Training Course: **"Fish Nutrition and Feeding"**, provided by Institut National de la Recherche Agronomique (INRA) NUMEA (Nutrition, Métabolisme, Aquaculture), France with the assistance and expertise of Agencia Estatal Consejo Superior de Investigaciones Cientificas (CSIC) (Spain), Wageningen University (WU) (the Netherlands) and University of Stirling (UoS) (United Kingdom), from 18 – 22 November 2019.

NAME HERE

Training Course Details

- This face-to-face training course focused on fish nutrition, physiology and feeding.
- A half day industry mini seminar gave the course participants an opportunity to exchange with industry professionals.
- The 5 day-course was taught by tutors from INRA, CSIC, WU and UoS.
- For more details, see www.aquaexcel2020.eu and / or contact the INRA contact person below.

Sandrine Skiba,
INRA NUMEA
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Annex 9: Check list

Deliverable Check list (to be checked by the "Deliverable leader")

	Check list		Comments
BEFORE	I have checked the due date and have planned completion in due time		*Please inform Management Team of any foreseen delays*
	The title corresponds to the title in the DOW		*If not please inform the Management Team with justification*
	The dissemination level corresponds to that indicated in the DOW		
	The contributors (authors) correspond to those indicated in the DOW		
	The Table of Contents has been validated with the Activity Leader		*Please validate the Table of Content with your Activity Leader before drafting the deliverable*
	I am using the AQUAEXCEL2020 deliverable template (title page, styles etc)		*Available in "Useful Documents" on the collaborative workspace*
The draft is ready			
AFTER	I have written a good summary at the beginning of the Deliverable		*A 1-2 pages maximum summary is mandatory (not formal but really informative on the content of the Deliverable)*
	The deliverable has been reviewed by all contributors (authors)		*Make sure all contributors have reviewed and approved the final version of the deliverable. You should leave sufficient time for this validation.*
	I have done a spell check and had the English verified		
	I have sent the final version to the WP Leader, to the 2nd Reviewer and to the Project coordinator (cc to the project manager) for approval		*Send the final draft to your WPLeader, the 2nd Reviewer and the coordinator with cc to the project manager on the 1st day of the due month and leave 2 weeks for feedback. Inform the reviewers of the changes (if any) you have made to address their comments. Once validated by the 2 reviewers and the coordinator, send the final version to the Project Manager who will then submit it to the EC.*