Programme: FP7 Cooperation
Theme 2 Food, Agriculture, Fisheries and Biotechnologies

Deliverable 8

Thematic Area Position Paper Template

Project Acronym :	AQUAINNOVA
Project title :	Supporting governance and multi-stakeholder participation in aquaculture research and innovation
Grant agreement number :	245238 – FP7-KBBE-2009-3
Project coordinator :	European Aquaculture Technology & Innovation Platform

Deliverable 8 is the Thematic Area Position Paper Template.

Within the structure and scope of EATIP, eight thematic areas (TA) of interest have been identified, each of which influences the long term sustainability of European Aquaculture:

- TA 1. Product quality, Consumer Safety & Health
- TA 2. Technology & Systems
- TA 3. Managing the Biological Lifecycle
- TA 4. Sustainable Feed Production
- TA 5. Integration with the Environment
- TA 6. Knowledge Management
- TA 7. Aquatic Animal Health and Welfare
- TA 8. Socio-economics & Management

The WP2 of Aquainnova is tasked with managing knowledge within the project, including developing a suite of tools and methodologies to assist the different Work Packages in the project implementation.

One of the tools developed for WP 3 – Sectoral Mapping and Benchmarking – is a common template (D8) for all TAs to be applied for the development of individual position papers.

The template outlines the structure of the position paper, which includes:

1) Sectoral and policy positions concerning the status and development of each TA, including
   - A review of European legislative issues affecting the subject
   - A review of governance structures, actions and programmes that influence development
2) An RTD summary per TA containing a compilation of past and in –progress EU RTD projects
   - TL of past EU funded RTD projects
   - New TL on in –progress RTD projects
3) Identification and basic assessment of research outcomes generated by EU research projects per TA and their potential

The position paper is intended to provide a background outline of the policy and legislation concerning the individual TA and a RTD summary giving an overview of all relevant EU funded RTD projects within FP 6 and FP 7. The structure of each Position Paper foreseen for EATIP is the following:

Part A: Policy and Legislation

Given that the working groups in every TA have a different background from both academia and industry, it is important to ensure that all TA WG members are up to speed on policy and legislation related to their Thematic Areas. This section will outline in less than 2 pages all the Relevant Policy and legislation related to the TA subject.

Content:

A1: Abstract
A2: Main Content
  A2.1: Key drivers
  A2.2: Description of the key policy/legislation elements
  A2.3: The Challenges with the current status quo
A3: Conclusions

Part B: RTD Summary

The summary will be based on the feedback received through the questionnaire for RTD coordinators (D6).

B1: Summary
B2: Annex of relevant Technical leaflets per TA including RTD matrix

Find hereafter as an example the draft Position Paper developed for TA 3 – Managing the Biological Lifecycle – composed of:

Part A. Policy and legislation issues with respect to the Biological Lifecycle
Part B. RTD synopsis - EU funded RTD projects relevant to TA3

Part A.
Policy and legislation issues with respect to the Biological Lifecycle

A1: Abstract/Summary

Lifecycle management topics are dependent on innovative knowledge-management leading to best practises within on one hand a strict environmental, health, welfare and quality context, and on the other hand an economical (cost-effective) context.

A2: Main Content

A2.1: Key drivers

Installing a sustainable aquaculture industry in Europe relates to a significant increase in production based on environmental-friendly, well-governed and quality-assured practices, and innovative technology for a diversity of species that also could support a recognized European leadership worldwide. A better control of the biological lifecycle with respect to husbandry and genetics, fry production and ongrowing procedures is therefore imperative.

A2.2: Description of the key policy/legislation elements (affecting the sector/ development)

a. From the communication of the EC to the European Parliament & The Council 'Building a sustainable future for aquaculture - A new impetus for the Strategy for the Sustainable Development of European Aquaculture' (Brussels, 8.4.2009: *COM(2009)162 final),* it is stated that:

- The EU must maintain a strong research and technological edge to stay at the forefront in this strategic area and improve the competitiveness of the aquaculture sector by encouraging it to continuously develop and use innovative technologies and management techniques.
- The EC shall ensure that the EU aquaculture industry develops in a way which is compatible with a high level of protection of the natural environment. On the same lines, aquatic food products that are manufactured in or imported to the EU shall comply with high protection standards of consumer health and safety. Optimal husbandry conditions, good health and adequate feed well suited to the physiological needs of the farmed aquatic animals are essential for optimal growth and production. Guaranteeing the welfare of farmed fish also contributes to a better image for the aquaculture industry.

b. In its 2002 Strategy, the Commission proposed that the financial intervention in favour of aquaculture be re-directed towards new priorities. Consequently, the FIFG regulation was amended in July 2004 to make it more congruent with the objectives of the aquaculture strategy. It will no longer consider the modernisation of existing enterprises a priority for assistance, because it is now preferable to focus on reorienting production towards new species. An increase in aquaculture production is still envisaged, but the Community financial support will concentrate on species

diversification and environmentally friendly production for species with good market prospects. The Commission believes that research on species diversification is a top priority, for both fish and molluscs. Selected new species must necessarily respond to customers' preferences, in accordance with new market trends. Efforts should possibly be oriented to species such as seaweed, molluscs and herbivorous fish, which are able to utilise the primary production more efficiently.

c. Another priority is the introduction of effective genetic improvement programmes using selective breeding, as this will lead to considerable gains in productivity. Introduction of new species should be carried out in such a way to avoid the introduction of diseases… As the introduction of new species for farming, in particular when they are not indigenous, may also lead to the introduction of diseases, good and careful management practices including preventative measures at farmers' level are essential, in addition to possible legislative implications. The European Commission recently brought forward a Proposal for a Council Regulation concerning use of alien and locally absent species in aquaculture, COM(2006)154 as part of its strategy for the sustainable development of European aquaculture, COM(2002)511. This proposal for a Regulation "seeks to introduce an EU framework to ensure adequate protection of the aquatic environment from the risks associated with the use of alien species in aquaculture, building on the existing voluntary ICES and EIFAC rules. For the purpose of the Regulation, aquaculture is taken to include activities such as bottom cultivation of mussels and both stocking and put-and-take fisheries, which use aquaculture techniques as their basis. The rationale behind the proposal is that, with the likelihood that the aquaculture industry will continue to use novel species in order to satisfy the needs of the market, it would "be prudent to decouple this economic growth from the potential threats to ecosystems posed by alien species by anticipating and preventing negative biological interaction with indigenous populations, including genetic change, and by restricting the spread of non-target species and other detrimental impacts. At the Brussels summit of 2003, the EU committed itself to maintain its leading role in promoting sustainable development on a global scale by, among other measures, ensuring the protection of the marine environment and natural resources, including biodiversity. As stated in the FABRE Vision document, genomics represents both a way and a tool for the aquaculture industry to achieve these goals. Genomic studies provide a bridge to nutrition, health, and more. The application of such knowledge will contribute to improving animal health, food safety, animal welfare, and the biodiversity of breeding populations. In the long run, they will boost the competitiveness of European farm animal breeding practises.

d. Another important concern of the European member states is the competitiveness of their industries, especially SMEs, and the determination of Europe to become the most dynamic knowledge-based economy in the world (European Council, Lisbon 2000). The European Research Area should be a means of attaining this objective. More research for breeding programmes and genomics will make a European scientific contribution to maintaining the license to produce, ensure long-term viability and maximise the socio-economic benefits of the European aquaculture industry. As the major industries have also interests outside Europe, the effects should not be limited to the European continent alone, and will have effects on the global aquaculture industry of the future.

A2.3: The Challenges (to be resolved) within the current status quo

- closing lifecycles of selected (new) species of FW fish, SW fish, shellfish, algae

- optimization of reproduction (breeding strategies for year-round production of high quality offspring)
- selective breeding programmes (fast growing, disease resistant, robust, value traits) and genetic markers
- adapting production treats for each part of the lifecycle for fully domesticated strains & new genomes
- good knowledge of larval biology & physiology, incl. environmentally driven phenotypic plasticity and functional genomics
- homogenous fry quality, including low deformity; Fry quality indices; effect fry quality on ongrowing
- sexing
- optimized husbandry practices year-round, incl microbial management, for broodstock, larvae and ongrowing stages
- polyculture techniques

A3: Conclusions

Part B.

RTD Synopsis: Thematic Area 3 – Managing the Biological Lifecycle

In its strategy on the sustainable development of European aquaculture (COM (2002)511), the European Commission identified the diversification of farmed species as a top priority. European aquaculture aims to improve its competitiveness through production of larger volumes and a decrease in imports. The starting point for the achievement of these goals lies in the improvement of factors in the areas of genetics and reproduction; larval and juvenile production and on growing

Larval, juvenile and on growing

The production and supply of sufficient quantities of healthy, competitive larval and juvenile fish is vital to the European Aquaculture Industry. The production of these larval stages must not entail excessive cost. FINEFISH and LUCIOPERCIMPROVE investigated possible methods of larval and juvenile improvement, while PROTENCH was concerned with on growing fish. SLIME- and PROEEL focused on the restoration of the European eel population and the reproduction in captivity.

- **LUCIOPERCIMPROVE (FP6)** - Improving egg and larval quality in pikeperch by broodstock management, husbandry, nutrition and sex control- developed reliable methods for securing the continuous supply of high quality eggs and larvae of pikeperch. The reproductive cycle of pikeperch can be controlled in captivity and out-season spawning can be obtained from cultured pikeperch breeders held under suitable temperature/photoperiod conditions. Producers can now provide the market with an all-year-round availability of portion-size pikeperch.

- **FINEFISH (FP6)** - Reduction of malformations of juvenile fish in hatcheries- Developed practical guidelines on how to avoid malformations in fish and produced diagnostic manuals on malformations for sea bass, sea bream, salmon, rainbow trout and cod. New knowledge gained on strategies to reduce malformations were summarised as guidelines for use as Best Practice for Hatcheries to reduce malformations.

- **PROEEL (FP7)** - Reproduction of European Eel: Towards a Self-sustained Aquaculture. The PRO-EEL project aims at reproducing European eel (Anguilla anguilla) in captivity. The objective is to develop standardised protocols for production of high quality gametes, viable eggs and feeding larvae of European eel.

- **PROTENCH (FP6)** aimed to develop and optimize a procedure for the artificial reproduction of the freshwater tench presently restricted to seasoned production. Problems in the areas of the conditions and methods required for artificial reproduction of tench, appropriate feed ratios (least cost diets) and animal welfare were resolved.

- **REPROSEED (FP7)** improved hatchery bivalve production by advancing knowledge in the physiological basis of early sexual maturation, gamete competency, immunity and metamorphosis, at cellular and molecular levels, including genomics and proteomics.

While the projects had different end goals a certain overlap in outputs was experienced, all projects investigated where improvements could be made to current husbandry techniques to improve the egg/larval production/fry production.

Other common outputs included:

- Improvement of environmental conditions (light, gas supplementation and temperature) to improve fish welfare.

- Investigating the effects of different husbandry and dietary factors on the reproductive physiology and nutritional status

- Producing protocols to ensure the survival and adequate growth rate of juveniles, and;

- Inducing out-of-season spawning through temperature and photoperiod control.

For example,

- **SLIME (FP6)** –aimed to test quantitative approaches to evaluate the status of national eel stocks at a river basin level, to derive reference points for sustainability, and to model the potential effect of legislative and technical measures aimed at stock recovery.

- **LIFECYCLE (FP7)** - Building a biological knowledge-base on fish lifecycles for competitive, sustainable European aquaculture. The project aims to improve competitiveness and

sustainability of European aquaculture. The focus will be on early developmental events, growth and environmental adaptation throughout the lifecyle, and on the physiology and immunology of key life-stage transitions, such as metamorphosis, smoltification and puberty. LIFECYLCE will focus on all major life stages of sea bass, sea bream, Atlantic salmon and rainbow trout.

- **SALMOTRIP (FP7)** - Feasibility study of Triploid Atlantic Salmon Production – is looking to enhance knowledge on how triploid salmon should be reared and their potential performance. This will determine if triploid salmon are suitable for farming as a means to minimize the impact of farmed fish on the environment (i.e. sterile escapees) while improving fish welfare and providing a consistent year long quality product.

- **SUDEVAB (FP7)** aims to solve the main technical problems encountered by abalone growers in Europe in the areas of pathology, genetics, nutrition and sustainable culture technology. Other issues which the project hopes to resolve are in the areas of legislation, hygiene and food safety and marketing issues.

- **PROSPAWN (FP7)** - Implementation of natural spawning for marine fish species in culture. The aims of the project are to improve the quality of off-spring and animal welfare and to improve the eggs' quality by implementing natural spawning for marine fish species in culture.

- **SELFDOTT (FP7)** - From capture based to self-sustained aquaculture. SELFDOTT will implement the existing knowledge on the artificial control of reproduction of the Atlantic bluefin tuna to obtain viable eggs, and study embryonic and larval development for the production of fry (juveniles). Suitable and environmentally performing feeds for growout will be developed, thus reducing or eliminating the practice of raw fish importation and feeding by the fattening industry.

- **SETTLE (FP7)** - Bivalve conditioning and settlement – keys to competitive hatchery production. The overall objective of the project is to foster year-round production of flat oyster and great scallop spat in hatcheries by controlling gonad development and maximise larval metamorphosis and settlement.

Genetics and Reproduction

Several projects focused on the use of new genomics technology and its application to aquaculture.

- Implementation of genomics strategies can be prohibitively expensive for smaller aquaculture ventures so **AQUAGENOME (FP6)** addressed how Small and Medium Enterprises (SMEs) can access and benefit from the use of genomics. A Technical Handbook on benchmarks for genomics activities, best practices and standards was developed. A gap analysis was completed and application of genomics to husbandry, growth, health and

welfare and environmental monitoring in aquaculture were discussed. The state-of-the-art and future vision for genomics in European Aquaculture was communicated to the European Commission.

- **AQUAFUNC (FP6)** aimed to integrate the outcome of all FP 5 and 6 projects using functional genomics in Aquaculture, to identify specific needs in this area, and to reduce repetition of research. A state-of-the-art review on several aspects of the use of functional genomics in aquaculture was published in a dedicated issue of Reviews in Fisheries Science.

- **AQUABREEDING (FP6)** conducted a review of current breeding practices used by the aquaculture sector and undertook a gap analysis. Guidelines on an AquaBreeding Vision were developed to highlight the key objectives of existing and future breeding programs needed to support the European aquaculture industry. The main research priorities for industry were identified and a technical handbook on Breeding Practices in the industry was developed. It defined a strategic research agenda for breeding techniques and established a directory of a Breeding and Reproduction Aquaculture Network to enhance partnerships between industry and academic research. In addition state-of the art reviews of breeding and reproduction for cod, salmon, brown trout, rainbow trout, charr, pacific oyster, seabass, seabream and turbot were conducted.

- **REPROFISH (FP6)** reviewed current research on fish reproduction strategies including sex differentiation, gonadogenesis, puberty control, gamete quality, broodstock management and biotechnologies to better understand the underlying causes of important industry issues such as sex ratio, precocious puberty and larval development control and to identify gap analysis.

- **GENIMPACT (FP6)** assessed the genetic impact of aquaculture on wild fish stocks. The use of genetics in domestication and risks associated with farming of transgenic fish were discussed. Summaries of current knowledge of the interaction between cultured and wild populations of Atlantic salmon, Atlantic cod, European sea bass, gilthead sea bream, turbot, carp, halibut, scallops, mussels, oysters and European lobster were generated. Tools to evaluate how aquaculture has a genetic impact on wild populations were discussed and aimed to establish preventive measures to ensure genetic conservation.

- **AQUAFIRST (FP6)** was concerned with how selective breeding could be used to reduce stress and disease in the aquaculture sector. Analyses led to the production of lists of genes of which expression was significantly up or down regulated after exposure to stress. A number of Expressed Sequence Tags (EST) were developed for aquaculture species. Quantitative Trait Loci for various traits have been characterized.

- **COMPETUS (FP6)** investigated how genetic selection could increase the competitiveness of sea bass culture. COMPETUS provided all participating SMEs with the information necessary

to evaluate the implementation of genetic selection programs in their own facilities. A technical handbook detailing the relative values of the tested strains and their potential for selective breeding was produced. The traits that may be the most efficiently genetically improved through selection in the fish were identified and sperm preserved - this will allow for the possibility of exploiting the best genetic variability of the fish.

- **PHARMAPOX (FP6)** -Chemistry, pharmacology and bioactivity of a novel apoptotic compound - a sex regulator in decapod crustaceans with promising environmental and medical applications. Guidelines and protocols for the large scale culture of diatoms were developed. Diatoms produce several secondary metabolites having defined bioactivity so protocols developed ensured the maximum conservation of secondary metabolites. Environmentally the protocols developed could potentially be used for the re-stocking of natural diatom populations - a key trophic species. Guidelines and protocols for the culture of small marine shrimp were developed and ensure good survival with minimum stress. This project yielded the first isolation of an apoptogenic factor still inactive for controlling shrimp sex and could allow for the production of all-male generations with associated economic advantages.

Future needs:

Integrating the outcome of projects utilising functional genomics and related technologies is undoubtedly a logical step. It will facilitate the building of a common knowledge base and more efficient resource sharing in these fields of research. Integration should have a number of positive effects, as it is expected that the synthesis of a larger data set will have a synergistic effect and give a more significant output. The improved knowledge and application of current genomic research findings will optimise European aquaculture and contribute to a sustainable future.

Many projects cited the need for a greater degree of knowledge transfer. There is an obvious need for the application of knowledge and transfer of genomics technology to industry. In addition, integration and communication of the different projects outcome would reduce research overlaps in the future. A lot of SMEs do not have access to new technologies or information on how to adopt selective breeding strategies, there is a need to give SMEs more information on breeding strategies to develop their business.

These projects provided industry with the knowledge to assist in developing more environmentally sustainable production of fish and shellfish. Information gathered during these projects provided industry with knowledge on the genetic impact aquaculture production has on native populations, and can be used by aquaculture, breeding, environmental and animal welfare organizations, and to provide policy makers with useful information. The merits of the genetic effects of culture practices and domestication as well as their implications for community biodiversity such as the use of triploid individuals need to be investigated further.

A full list of the projects undertaken in Thematic Area 3 – Managing the biological lifecycle can be found in the Annex. More detailed information is provided in the Technical Leaflet (TL) describing the main outputs and deliverables of each project.

Thematic Area 3: Managing the Biological Lifecycle

FP	Acronym	Project title
6	AQUABREEDING	Improving stock rearing in aquaculture through applied genetics knowledge
6	AQUAFISRT	Combined genetic and functional genomic approaches for stress and disease resistance marker-assisted selection in fish and shellfish
6	AQUAFUNC	Integrated knowledge on functional genomics in sustainable aquaculture
6	AQUAGENOME	Genomics in fish and shellfish from research to aquaculture
6	COMPETUS	Genetic improvement of farmed sea bass, *Dicentrarchus labrax*: strain testing and response to selection
6	FINEFISH	Reduction of malformations of juvenile fish in hatcheries
6	GENIMPACT	Evaluation of genetic impact of aquaculture activities on native populations: a European Network
7	LIFECYCLE	Building a biological knowledge-base on fish lifecycles for competitive, sustainable European aquaculture.
6	LUCIOPERCIMPROVE	Improving egg and larval quality in pikeperch by broodstock management, husbandry, nutrition and sex control
6	PHARMAPOX	Chemistry, pharmacology and bioactivity of a novel apoptotic compound - a sex regulator in decapod crustaceans with promising environmental and medical applications
7	PROEEL	Reproduction of European Eel: Towards a Self-sustained Aquaculture
7	PROSPAWN	Implementation of natural spawning for marine fish species in culture.
6	PROTENCH	Intensive and sustainable culture of the freshwater species tench
6	REPROFISH	Understanding and communicating fish reproduction research
6	REPROSEED	REsearch to improve PROduction of SEED of established and emerging bivalve species in European hatcheries
7	SALMOTRIP	Feasibility study of Triploid Atlantic Salmon Production
7	SELFDOTT	From capture based to self-sustained aquaculture.
7	SETTLE	Bivalve conditioning and settlement – keys to competitive hatchery production.
6	SLIME	Study Leading to Informed Management for Eel - Restoration of the European eel population; pilot studies for a scientific framework in support of sustainable management

7	**SUDEVAB**	Sustainable Development of European SMEs Engaged in Abalone Aquaculture.