Aquaculture Forum
BREMERHAVEN

Bremerhaven Declaration

on the Future of Fish Nutrition and Aquaculture Technology

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Part I

Preamble and Recommendations

Workshop III **February 18–19, 2013**

FINFISH NUTRITION AND AQUACULTURE TECHNOLOGY AT THE CROSSROADS

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Investment in sustainable fisheries
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BREMERHAVEN DECLARATION

on the Future of Fish Nutrition and Aquaculture Technology

PREAMBLE

Workshop III of the Aquaculture Forum Bremerhaven was attended by 103 participants from 16 countries, representing experts from industry, science, investors, regulatory authorities and consumers.
Participants discussed a number of pertinent issues related to finfish and invertebrate (shrimps, bivalves) nutrition and latest trends in aquaculture technology including high-tech, low-tech and integrated aquaculture systems. Participants

- **recognize** that with the expansion of the aquaculture industry, conventional feed resources will not be sufficient to meet the future feed requirements (quality and volumes) of the industry

- **realize** that new protein resources may not necessarily be the prime concern to overcome nutrient shortages (e.g. lipids) when feeding aquaculture species

- **note** that alternative sources for highly unsaturated fatty acids will be increasingly required to meet the demand for nutritional quality of the final products

- **confirm** that water resources will be at a premium in many regions, facing increasing competition for water from various resource users (e.g. drinking water, irrigation, energy and other industries), therefore, aquaculture will require increasingly water-saving technologies and may benefit from combining water usage with agro-industries.

- **find** that the aquaculture industry is in the middle of a transitional phase from an empirical business approach towards a knowledge-based bio-industry that must pursue new concepts and products for its sustainable development

- **observe** that recycling of water is only one issue gaining importance in many parts of the world while additional and simultaneous recycling of any waste originating from the culture activity will increasingly become a necessity to improve cost-effectiveness and environmental compatability

- **believe** that the use of integrated farming systems can also greatly enhance overall system performance while gaining economic efficiency and environmental compatibility, and

- **recognize** that aquaculture can play an important role in conservation of endangered species if proper strategies are employed.

Following these discussions by all participants and recognizing the strategic visions expressed by the FAO Millennium Aquaculture Conference in Bangkok 2000 [1] and Phuket (Thailand) 2010[2] as well as the European strategic agenda for research and development focussing on "The Future of European Aquaculture (2012[3]), the workshop organizers, session chairs, and speakers formulated a series of specific recommendations. We call upon national, international, inter-governmental agencies as well as the industries, potential investors, scientists, engineers, regulators and NGOs to strongly support these recommendations with the aim to ensure the further development of a healthy and environmentally sustainable industry that can contribute to meet the future demands of the society for food of high nutritional quality.

1 Rosenthal, H., Varadi, L. (Chairs) 2000. Thematic Session 2: Technologies for sustainable aquaculture development (aquaculture systems and species). Pp. 31 -39. In: NACA-FAO, 2000. Report of the Conference on Aquaculture in the Third Millenium. , February 20-25, 2000, Bangkok, Thailand. Publisher NACA, Bangkok and FAI, Rome. 120 pp.

2 FAO/NACA. 2012. Farming the waters for people and food. R.P Subasinghe, J.R. Arthur, D.M. Bartley, S.S. de Silva, M. Halwart, N. Hishamunda, C.V. Mohan and P. Sorgeloos. (eds.). Proceedings of the Global Conference on Aquaculture 2010, Phuket, Thailand, 22-25 September 2010. FAO, Rome and NACA, Bangkok, 896 pp.

3 EATIP (European Aquaculture Technology and Innovation Platform), 2012. The future of European Aquaculture: our vision = A strategic agenda for research and innovation. FSC (Co8 1877), 41 pp.

RECOMMENDATIONS

Recommendation 1

The aquaculture industry should be seen as an equal right resource user that also needs protection from the externalities of other aquatic and land-based resource users and industries competing for the same resources. In this context there is also an urgent need to simplify regulatory frameworks for aquaculture systems, which are presently highly regulated in many countries within the EU. This can be done without compromising environmental objectives and targets while removing unnecessary bureaucratic barriers that distort the competitiveness of European aquaculture.
Aquaculture system planning should from the start define the externalities and explore their internalization. There is a need to enhance the flow of information on developments in aquaculture systems and production to increase transparency and gain public and consumer acceptance.

Recommendation 2

There is an urgent need to invest in research and development of alternatives for fish-meal and fish-oil resources, incorporated with appropriate quality control measures to maintain the quality level of the final products.

Recommendation 3

Specific research being undertaken when exploring alternatives for fish meal and fish oils in feeds with a primary focus on

- suitability of alternatives to meet species-specific requirements
- the assessment of ecological implications of increasing zooplankton fisheries producing fish oil supplements or replacements,
- the development of oil-seed crops and single-celled micro-organisms to produce n-3 higly unsaturated fatty acids (n-3 HUFA)
- cost-effective production of fish oil substitutes by bio-technological processes
- to improve the intrinsic fatty acid metabolism of fish through breeding programmes to confer a trait of increased n-3HUFA content in aquaculture products

Recommendation 4

There is an urgent need to plan for the comprehensive development of land- and water-based infrastructures needed for the technical and logistical support and supply of Open Ocean Aquaculture that incorporates the multi-dimensional interacting factors for successful operations.

Recommendation 5

There is an urgent need for more predictable and cost-effective production of high-quality larvae, fry and fingerlings for stocking aquaculture grow-out facilities, through a better understanding of
(a) the environmental conditions in the larviculture tanks as well as in the live food production units,
(b) the response of the immune systems of aquaculture species under specific treatments (e.g. application of prebiotics and probiotics) and,
(c) the requirements for a greatly improved microbial management within hatcheries (i.e. use of innovative strategies for manipulation of microbial composition and/or reducing microbial virulence, e.g. interaction with microbial quorum sensing, role of heat shock proteins in disease control).

Recommendation 6

Hatchery rearing strategies are urgently needed for endangered species to produce progeny with the fitness for survival in a highly competitive and harsh outside environment. Such methods and strategies must be designed to avoid outbreeding depression (maintaining the natural genetic integrity of the species of concern)

Recommendation 7

The potential to apply modern approaches in recirculating aquaculture systems should be greatly enhanced with due consideration to the economy of the scale.

Recommendation 8

Aquaculture Recirculating System (RAS) design must take species-specific requirements into considerations, the design and layout of which must serve the specifically targeted products while increasingly employing process control technology.

Recommendation 9

There is a need to develop technology standards for RAS and its operational components (including materials) while also improving our knowledge base to more accurately predict production capacity (including safety margins) as well as appropriate risk assessment methodologies (including sound contingency planning).

Recommendation 10

There is an urgent need to improve education on principles and on operational practices for all modern aquaculture systems (in particular for RAS) at a multi-disciplinary, trans-disciplinary and a fairly standardized level including appropriate certification.

Recommendation 11

Land-based integrated agriculture-aquaculture systems need to be assessed and tested in light of modern biotechnological, socio-economic, and environmental criteria to define practical combinations of various species suited for local markets. The economic scenarios under severe resource competition in various European regions should also be considered.

Recommendation 12

The development of integrated farming systems that employ a mix of species of various trophic levels, thereby enhancing environmental compatibility of aquaculture, should be promoted in suitable coastal areas. New and extended criteria for area licences are needed to accommodate various system components to better utilize natural resources and to protect the environment. The combined cultivation of organisms of different trophic levels confers environmental and economic benefits, but may introduce risks, such as new disease transfer pathways or issues concerning fish and plant hygiene and taste. This field is currently widely underrepresented in aquaculture research and specific recommendations are presented below.

Recommendation 13

As new Integrated Multi-Trophic Aquaculture (IMTA) systems are designed, there is an urgent need to develop carrying capacity models based on mass balance models for such systems while also the ecology of diseases in these simple ecosystems must be fully investigated to avoid unforeseen impacts of disease outbreaks that limit the development of this technology and jeopardize economic benefits.

Recommendation 14

If protein and lipid sources from IMTA systems are to be used in aquaculture production a framework must be developed to ensure that these products are free of aquatic pathogens with a view to avoiding biomagnification of pathogens within the food chain.

Recommendation 15

It is strongly recommended to support research and development projects on the potential of greenhouse crop production with aquaculture production (e.g. hydroponics / aeroponics) to elucidate mass flows between the compartments of such systems as well as to enhance bio-economic resource use, particularly when contributing to rural economy.

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Contributions to the Bremerhaven Declaration on **"the Future of Fish Nutrition and Aquaculture Technology"** were received from Members of the Programme Committee, Session Chairs and speakers while participants presented their views during the Panel discussion on day two of the workshop.
These views were accommodated as much as possible by the Editorial Committee (Rosenthal, Buck, Koch) Those participants who offered support to the views expressed in this Declaration are listed at the end of Part II of the Declaration.