CHAIR'S SUMMARY[i]

The UN Millennium Development Goals include cutting the share of the global population suffering from hunger by half by 2015[ii]. Progress was steady at first - before the rise in food prices in 2008 and the global recession wiped out many of the gains. This may turn out to be merely a temporary setback. However, there are fears for longer term food security, with some experts even warning of a 'perfect storm' as population is forecast to grow by 50% from now to mid-century, while agricultural land is lost to urbanisation and climate change introduces a number of uncertainties. This pessimistic outlook assumes it will not be possible to increase food supplies fast enough to keep up with demand.

Against this background, aquaculture can play a role in contributing to food security. With many stocks fully exploited, there is little scope for expansion of capture fisheries. Annual average per capita consumption of capture fish actually fell by 10.6% over 1995-2007, from 10.6 to 9.5 kg per person. Aquaculture on the other hand has shown great potential. Globally, aquaculture has been the fastest growing animal food producing sector for over half a century, with production (excluding aquatic plants) expanding at 8.1% per year since 1961, compared with 3% for terrestrial farmed meat production, 3.4% for egg production, and 1.5% for milk production. Per capita consumption of fish from aquaculture grew from 4.3 to 7.5 kg over 1995-2007, an increase of 74%. However, wide differences are seen geographically as to the potential of aquaculture development.

In 2007, aquaculture overtook capture fisheries and supplied more than 50% of aquatic products for direct food consumption. Although climate change and other factors might constrain developments, there are powerful drivers for expansion, including population and income growth fuelling demand for aquatic foods, coupled with supply limitations from capture fisheries. Global output from aquaculture may need to increase from 52 million tonnes in 2007 to 80 million tonnes or more by 2030 to meet demand. Success is not guaranteed though and the sector will have to manage biological risks such as disease; system risks such as equipment failures and water problems; economic and market risks such as price volatility of inputs and products, changing consumer preferences due to dietary considerations and perceptions about aquaculture products; and political risks affecting for example the legal context for production or trade.

The workshop

With a huge market plus a dynamic, innovative supply chain in OECD countries backed up by solid research capacities, aquaculture's future is promising. It does however have to address a number of challenges from both inside and outside the sector if it is to realise its full potential.

As a contribution to this process, the OECD's Committee for Fisheries organised a workshop entitled *Advancing the Aquaculture Agenda: Policies to ensure a sustainable aquaculture sector*, hosted by the French Ministry for Food, Agriculture and Fisheries at OECD Headquarters in Paris on 15-16 April, 2010. Policy makers, technical experts, international organisations, the private sector and NGOs took part in the workshop and

contributed to examining policy challenges that governments face in aquaculture development. Over 80 participants used this platform to discuss the critical economic, environmental and social aspects of the aquaculture sector and analysed interactions with other sectors.

The objectives of the workshop were to:

- Provide participants with information about the "state of the art" and trends in aquaculture;
- Encourage mutual learning by sharing best practices and experiences in aquaculture management and development, including intersectoral aspects;
- Identify key areas for improving the business environment for aquaculture – including perspectives from the private sector and from international organisations and NGOs;
- Understand the opportunities and challenges of aquaculture for OECD countries with regard to policy coherence for development and
- Outline innovative pathways for sustainable aquaculture for OECD countries.

In 2009 the OECD Meeting of the Council at Ministerial Level adopted the Declaration on Green Growth[iii]. As outlined in this Declaration, the OECD can, through policy analysis and identification of best practices, assist countries in their efforts to respond to the growing policy demands to foster green growth and work with countries to develop further measures to build sustainable economies. The aquaculture sector is well placed to pioneer the Green Growth approach and the workshop built extensively on case studies from OECD member economies and on insights from well established experts to share important experiences and identify best practices.

This report is the Chair's summary of the key messages coming out of the two-day event. It is based on the discussions that took place among participants and the important messages that are contained in the various presentations given at the workshop. Some of these presentations built on papers and case studies compiled in the following chapters of the proceedings. Some papers that could not be presented at the workshop and the outcome of an OECD *Survey on Conditions for Establishing Aquaculture Production Sites* are also included in the proceedings. The publication concludes with the biographies of the speakers and authors, followed by the list of participants.

Summary of discussions

Best practices in aquaculture management and development

The workshop put aquaculture in the broader context of food security and Green Growth. Global aquaculture production in 2007 was valued at USD 94.5 billion, for a total of 65.2 million tonnes, produced for the vast majority in developing countries. Although most aquaculture production derives from fewer than a dozen species (fish grown in ponds or cages, shrimp or prawn in ponds, molluscs and seaweeds in beds or on suspended lines) biodiversity in aquaculture is high, with over 340 different species of farmed aquatic plants and animals produced in 2007.

Unlike capture fisheries, where the bulk of harvested species are carnivores high on the aquatic food chain, the mainstay of farmed fish production are omnivorous and herbivorous

species positioned lower on the chain (*e.g.* carps, tilapia, catfish). However, in OECD and other more advanced economies, high value, high trophic level carnivorous fish species are favoured, both in terms of production and in terms of consumption (*e.g.* salmon, sea bass and bream), reflecting market demand for these species.

The paper entitled *Growing the wealth of aquaculture: perspective and potential* comprehensively explores the features of the sector's recent growth, its emerging opportunities and constraints, across major producing regions, species groups and production systems. It defines and examines the conditions of development for the sector, and considers potential features of growth and expansion, commercial structure, trade, supply and value chain development, and the implications of these at strategic investment and policy levels. Many of these topics are further illustrated and expanded in these proceedings.

Aquaculture can contribute substantially to food security. The nutritional quality of seafood from aquaculture may help reduce the number of people suffering from malnutrition, the number one killer today. The protein and lipid quality of aquaculture products also plays an important role in developed countries. Recent research results show that lifestyle diseases such as overweight and obesity may be reduced on a seafood-rich diet.

The workshop discussions benefited extensively from OECD country case studies on best practices in aquaculture management and development, in particular with regard to governance, to managing aquaculture-generated externalities and to managing externalities affecting aquaculture. The country case studies were complemented by presentations on the EU-financed CONSENSUS[iv] project which developed a multi-stakeholder platform for sustainable aquaculture in Europe; a presentation on integrated multi-trophic aquaculture (IMTA) as a responsible practice providing diversified seafood products while rendering services to the ecosystem and a presentation on hypoxia and eutrophication in marine waters.

Many of the challenges in aquaculture production, such as environmental externalities, are common to the food industry as a whole, and indeed are just as important for capture fisheries as for aquaculture. There are parallels to the patterns of intensification in agriculture, for instance in terms of conflicts over access to space and increases in negative environmental externalities. Agricultural productivity has expanded remarkably in a very short time due to massive improvements in production technologies and the "industrialisation" of animal rearing – now also observable in aquaculture production. Seafood availability has increased and consumers have benefited considerably, but the environmental price is high (*e.g.* in terms of pollution; threats to biodiversity; diseases). Better information is vital to understand the interactions between aquaculture and the environment and to tackle negative externalities. While the knowledge base on the challenges in aquaculture has advanced significantly over recent years, communication of that knowledge has been somewhat lacking. However, policy makers and the aquaculture sector in general are increasingly conscious of the challenges and are taking steps to address these issues, through mitigation activities as well as through more comprehensive sector strategies.

Despite its long history, aquaculture at the current commercial scale is still a rather young industry and the coming years are likely to see it undergo a number of transformations common to other sectors. These changes will be driven by economic factors, such as consolidation with more competitive enterprises taking over rivals, but also by technical factors to optimise production. For example, there is currently surprisingly

little standardisation of equipment except for modern cages and some aerators and feeding systems, and system technologies are often borrowed from other branches such as marine engineering. Public policy shows a similarly wide variety of approaches, ranging from almost total neglect to highly focused support and control of the aquaculture sector.

Yet one recurring theme is the need for policy coherence to allow the sector to achieve its potential and to minimize conflicts with other competing resource users. Spain for example is currently implementing 17 national plans for the promotion and development of marine aquaculture. The original aims of the plans were to introduce new species into aquaculture production and to improve technical production conditions, but in recent years more focus has been given to environmental and health aspects, analytical methodologies, product quality, technologies and management and planning. The national plans are important contributions to improve competitiveness through the optimisation of production systems and the incorporation of new technologies; to stimulate research; to improve administrative processes and to generate knowledge on environmental aspects. The French administration on the other hand has concentrated interventions around three priorities: access to space (in particular in coastal areas), increased investment in research and development and communication campaigns to improve the sector's image.

In Ireland, the unique Co-ordinated Local Aquaculture Management Systems (CLAMS) process is a nationwide initiative to manage the development of aquaculture in bays and inshore waters throughout Ireland at a local level. In each case, the plan fully integrates aquaculture interests with relevant national policies, as well as: Single Bay Management practices, which were initially introduced by salmon farmers to co-operatively tackle a range of issues, and have been extended to all aquaculture species; the interests of other groups using the bays and inshore waters; Integrated Coastal Zone Management plans, and County Development plans.

Recommendations from a Chilean programme on combating sea lice include among other to establish a national surveillance and control system applicable to the whole industry and to coordinate treatments in connected geographic production areas. Norwegian experience underlines the important role of the regulatory authorities, not just in setting technical standards, but in making reporting of escapes mandatory and in defining a mechanism to analyze and learn from the collected information. In addition, compulsory, technical assessments to determine the causes of large-scale, escape incidents have proved their worth.

Dutch finfish farms have adopted a radically different approach to controlling environmental impacts. The sector is based solely on recirculation aquaculture systems (RAS), *i.e*. land-based fish production systems in which water from the rearing tanks is re-used after mechanical and biological purification to reduce water and energy consumption as well as nutrient emissions to the environment. The water consumption in RAS is entirely based on water exchange to compensate for evaporation, incidental losses and to control water quality. However, RAS imply high capital and operational costs, specific disease treatments and intensive management and skill requirements.

Sustainable aquaculture should be ecologically efficient, environmentally acceptable, product-diversified, profitable and beneficial to society. Integrated multi-trophic aquaculture (IMTA) pursues these objectives by cultivating fed species (*e.g.* finfish fed sustainable commercial diets) with extractive species, which utilise the inorganic (*e.g.* seaweeds) and organic (*e.g*. suspension- and deposit-feeders) excess nutrients from aquaculture for their growth. Thus, extractive species produce valuable biomass, while simultaneously rendering biomitigating services. In this way, some of the externalities of fed monoculture are internalised, increasing the overall sustainability, profitability and

resilience of aquaculture farms. It was argued that the economic values of the environmental and societal services of extractive species should be recognized and accounted for in the evaluation of IMTA to create economic incentives to further develop and implement IMTA. Seaweeds and invertebrates produced in IMTA systems could be considered as candidates for nutrient/carbon trading credits within the broader context of ecosystem goods and services and IMTA could become an integral part of coastal regulatory and management frameworks. While the technical feasibilities of introducing IMTA on a larger scale has been proved in Asia, in many other parts of the world the rapid expansion of such systems is challenged by reasons of social acceptance.

In terms of policy challenges, discussions identified the crucial role of appropriate spatial management (marine, coastal, inland) and of stakeholder participation in aquaculture planning processes. To enable progress, producer compliance with regulations, the sectors' acceptance by third parties and policy coherence are also crucial elements. Aquaculture is in competition with other uses for (access to) water and land resources. It is influenced by the activities of other user and, in turn, can have an impact on them. In this regards, many OECD countries have already implemented zoning policies and established forms of stakeholder consultation platforms but that these instruments need to be adaptive so as to deal with emerging issues (*e.g.* new production techniques like off-shore farming; disease management; social implications of aquaculture). Effective communication lines between the stakeholders and policy makers are needed for this purpose.

Workshop participants also called for the development of the sectors' capacity to attract investment. This capacity depends among others on the efficiency of the licence/permit allocation system (in terms of timeliness, complexity, duration and renewal) which represents a form of 'political' risk for investors that needs to be added to the natural, systemic and the economic risks. The development of improved farming technologies (*e.g.* IMTA, RAS) and the adoption of best practices for disease, escape and environmental impact management are additional instruments to increase the economic performance – and hence investment attractiveness - of the aquaculture industry.

Enhancing economic conditions for aquaculture

There are common challenges for the public and the private sector in terms of science and research: for example 'green' technologies serve public sustainability objectives but also accommodate private needs to cut energy costs in production and to comply with increasingly stringent environmental regulations. Reducing production costs through improved efficiency is for example achieved through better fishmeal/oil-based feed formulation, alleviating simultaneously pressure on capture fish stocks.

All farmed species are susceptible to stress factors (*e.g.* stocking density, grading, mixing of species, predators, handling, transport, removal of fish from water, temperature changes, inadequate light). Fishes' responses to stress include hormone imbalance, osmoregulation disruption and immuno-suppression, amongst others. As a result, the fish is more susceptible to disease, and possibly prone to bacterial carriage, with possible consequences for product safety. Animal welfare is increasingly incorporated in best aquaculture practices or guidelines developed by both, public and private entities, and needs to find its way into the production cost equation. The European Food Safety Authority has already produced a number of recommendations, based on a risk assessment methodology to derive a qualitative ranking and identify significant hazards. The scores indicate why the hazard achieved a high score and support recommendations to improve the welfare of fish.

Markets for aquaculture products are changing. There is a trend towards contract buying based on fixed prices as demand is increasingly concentrated, in particular with major retail chains. Faced with relatively stagnating prices and competition from third countries, European aquaculture producers react with improving production efficiency and increasing concentration as the traditional small medium enterprise (SME) model become risky. To progress and potentially preserve the SME structure, the industry calls for harmonization in regulation, privileged lending rates, accessible venture capital and fiscal reductions for efforts in environmental investments. Sustainability was however acknowledged as the most important attribute for ensuring a positive future for the aquaculture industry.

A more sustainable sector would also reinforce positive consumer perceptions. As to the sector's image, overall, seafood products have a neutral to positive image, while consumer awareness about aquaculture remains rather low. When asked people tend to express a preference for wild fish, while in practice shoppers pay little attention to origin when buying fish products. Partly, this is because consumers' knowledge of aquaculture and fisheries is limited and the surveys reveal no consistent opinions regarding the taste of farmed products. Aquaculture products however have the intrinsic advantage of a relatively stable supply and lower prices compared to captured species. Those positive features are counterbalanced by negative perceptions about the use of fish meal/oil, hormones and drugs, and the environmental implications of aquaculture production.

Risk and uncertainty issues in aquaculture production are important. The main causes for loss in aquaculture are diseases, algae blooms and adverse weather conditions. Models developed to capture uncertainties and risks are based on collected and elaborated data and are supposed to reduce some of the uncertainty by forecasting risk and its impact. Being insured can facilitate access to capital and the adoption of best practices can hugely reduce risk and hence the insurance premium.

One of aquacultures main environmental impacts is on marine capture fisheries through demand for wild fish for feed. Feed is the biggest cost factor in carnivorous aquaculture and also one of the most criticised areas in terms of sustainability. It is therefore important that aquaculture pays particular attention to the efficient use of feeds and the inclusion of responsibly sourced ingredients. However, the protein conversion ratio is much better in finfish than in other animal productions. As an example 100 kg of feed pellets may produce 110 kg of trout, while it only produces 20 kg of poultry - the land animal with the most efficient feed conversion ratio. Increased uses of plant proteins as substitutes for fishmeal and fish oil in feed are under development.

With respect to aquaculture in developing countries, the future industry structure is likely to see increasing differentiation between globally competing producers that will integrate into modern supply chains in major markets; nationally and regionally specialised commercial sectors - mainly for prosperous urban markets - and local development of small-scale production for rural markets or specialised niche supplies. The small scale sector could however play an important role in rural development, food security and poverty eradication, Experience from Malawi where fish ponds were added to smallholdings shows that total farm productivity improved and that total farm income increased by 61%. As Africa and Asia become increasingly urbanised, there are likely to be new markets for fish products from peri-urban aquaculture as there are already for agriculture.

Fish products generally are amongst the most traded foods internationally, and OECD countries import around 60% of their supplies. However, despite a flourishing international trade, WTO agriculture agreements exclude fish, and there are no separate tariff lines for aquaculture products in most WTO member countries, except for Iceland and Norway. This

means that there are no global trade statistics tracing aquaculture products. With the increasing importance of aquaculture production in international seafood trade this may however have to change in the future.

One particular market development triggered by the increase in aquaculture production concerns the role of standards and certification for aquaculture products. The increasing commercial success of some farmed species translates, in some cases, into the establishment of trade barriers: domestic industries in the US for example filed cases against imports of farmed shrimp, salmon and more recently Vietnamese pangasius. The industry has developed its own quality standards for the production of the major species. In many OECD countries, full traceability on inputs and rearing practices is imposed for assuring food safety. The Global Aquaculture Alliance, WWF's Aquaculture Dialogues and the Aquaculture Stewardship Council are examples of standard-owning entities that have recognised the need to boost the overall reputation of the industry.

Key messages

The main policy messages can be summarised as follows:

How can the contribution of aquaculture to food security, climate change adaptation and Green Growth be optimized?

The aquaculture sector is an important contributor to the Green Growth Agenda – but political will needs to be harnessed to further support Green Growth in aquaculture. This calls among other for:

- Risk reduction to encourage sustainable long-term investment in the capital intensive aquaculture sector in OECD countries:
  - Encourage and recognise the use of better/best practices by producers;
  - Support adaptive innovation (*e.g.* improved water use, selective breeding, feed formulation).
- Ensure acceptance of sustainable aquaculture by limiting negative externalities on the (marine) environment:
  - Develop innovative solutions (*e.g.* IMTA);
  - Optimize management of escapes, disease, pollution and other externalities;
  - Implement monitoring and early-warning systems.
- Improve the image of the industry:
  - Develop pro-active information exchange with society and policy-makers.

How to translate lessons learned from best practices into specific policy action?

- Galvanize political will:
  - Develop clear and realistic national or regional plans for aquaculture development;
  - Include aquaculture in marine, coastal and inland spatial planning to minimize conflict among user groups;

- Develop flexible regulatory frameworks with coordination across government agencies and levels of government (*e.g*. agriculture, fish, urbanization);
- Support targeted research and development to promote:
- Use of green technologies and promotion of sustainable aquaculture species (*e.g.* in terms of feed, nutritional value, GMO);
- Market-oriented production; benefitting from changing consumption patterns (*e.g*. healthy diet, preference for Omega3-rich food).

Timely and effective dialogue between all stakeholders: how can it be achieved?

- Ensure that stakeholders are involved in developing aquaculture plans and in their implementation;
- Consider commercial perspectives to serve public and private interests;
- Conduct information campaigns to make sure sustainable products and production methods are valued by the market and accepted by consumers.

Dealing with emerging issues: how to keep regulatory frameworks flexible?

If the aquaculture sector is to be sustainable, a holistic approach is needed in which profitability, environmental risk and social acceptability are defined and targeted, and where aquaculture is seen as part of a wider picture incorporating not only food supply, but also broader ecosystem services that either contribute to it and/or depend on it.

All workshop presentations are available on the OECD website – www.oecd.org/document/3/0,3343,en_2649_33901_44041283_1_1_1_37401,00.html#Presentations.

Notes

[i] By Professor Torger Børresen, DTU Denmark.

[ii] Compared to 1990 values.

[iii] www.oecd.org/dataoecd/58/34/44077822.pdf.

[iv] www.euraquaculture.info.