

4. OUTLOOK

4.1. Aquaculture for rural development and poverty alleviation

- There is a great potential of aquaculture to contribute rural development in certain regions in Europe (coastal areas and Central and Eastern Europe), which should be better considered and utilized in the future.
- Besides agriculture and forestry, aquaculture should be recognized as an important component of rural development, which may have a primary importance in the development of rural livelihood in certain localities; such approach, however, require much deeper understanding by policy makers in Central and Eastern Europe.
- The integration between aquaculture and agriculture could be a good means to improve rural life through the better use of resources; however, there is need to overcome institutional constraints at various levels to achieve better integration of the two sectors.
- The main element of aquaculture will remain food production, however, the importance of various services in recreation, natural conservation, and water management will increase in the future, which will provide employment and business opportunities for the rural population.
- Communal autonomy and self-determination must be improved all over Central and Eastern Europe, which are basic preconditions of the development of social and economic conditions in rural areas.

4.2. Aquaculture and its contribution to food security (production/supply)

- The contribution of aquaculture to food security will remain important in certain regions of Europe (mostly in coastal areas), however not directly through the consumption of the produced fish, but indirectly through the provision of income for the population involved in aquaculture.
- The share of fish consumption may be decreasing in the total meat consumption of the population, however the aquaculture production will increase in absolute value, taking also into account the decreasing supply from capture fisheries, which will be substituted in an increasing ratio by aquaculture products.
- The unique feature of aquaculture products (wide range of species, large variety of different processed products, enrichment by PUFA and other indispensable nutrients) could be utilized as far as possible in order to compete successfully with other non-fish food products.
- Although there is a room for considerable expansion of fish consumption in the Central and Eastern European region, the increase of the consumption of aquaculture products will be slow, due to economic and structural problems in most of the countries in this region.

4.3. Aquaculture and capacity building requirement

- In spite of the trend towards reduced government intervention in development, there is a greater need for centralized regulations to ensure equitable allocation and sustainable management of resources, and the role of public consensus and participation in decision making will also be increasing.
- Integrated river basin and coastal area, and landscape management have primary importance, which require multi-sectoral integration with the involvement of various government agencies and stakeholders.
- The development of institutional capacity still require considerable national and international efforts in Central and Eastern Europe, with special regard to the establishment of fish inspection systems (quality and health control); technical training facilities; business management training; advisory service training and fisheries information systems.

4.4. Farm management and production technology methods

- The development of aquaculture production will likely follow the development pattern of other agricultural food production sectors (increasing intensity level, wider use of modern technologies and advanced equipment, higher level of processing and wider implementation of HACCP systems, more focus on high quality products etc.) in all sub-sectors of aquaculture.
- There will be an increasing diversification trend in pond aquaculture, with two main directions of intensification and waste water treatment, while a part of the extensive fish pond areas in Europe will provide services for recreation, natural conservation and water management.
- The spreading of water efficient and environment friendly recycling systems for the production of high value species is expected in the future all over in Europe, especially in those regions, where geothermal water resources are available.
- Cage aquaculture will continue to be an important production technology of marine species mainly in Scandinavia and the Mediterranean, however the trend toward wider use of off-shore cages could be stronger.
- There is a considerable scope for much greater integration among the various users of the aquatic resources, however the elaboration of complex integrated technologies requires the strengthening of research and development in this field, and from the other side, corresponding adjustment of the institutional system.
- A key element of the future competitiveness and success of aquaculture is the improvement of the existing management practices mainly through specific training programs with special regard to small and medium size enterprises, and to the Central and Eastern European region.

4.5. Seed production

- Modern fish hatcheries and hatchery technologies have been available throughout in Europe (not only for finfishes, but also for molluscs and crustaceans), which provide a solid basis for future development of aquaculture.
- Besides commercially important species, various indigenous species for stock enhancement, and endangered indigenous species will also be propagated in increasing number of these hatcheries in the future.
- The fish seed supply of the aquaculture industry will largely be based on high quality seeds produced in centralized hatcheries, where the origin of broodstock and production processes can be controlled efficiently according to the increasingly stringent regulations and quality standards.
- The networking of centralized hatcheries can also be expected in the near future in order to organize seed supply of some important species in a larger region, and to make joint efforts for genetic improvement, disease eradication support, and technology development.
- National and international support should continue, focusing on the development of seed supplying centers in rural areas, with special regard to mussel producing coastal areas.

4.6. Genetics and reproduction

- There is a tremendous scope in European aquaculture to increase productivity, product quality and disease resistance by applying various genetic improvement techniques, among which the conventional selective breeding and hybridization still offer great possibilities.
- There is an acknowledged necessity for further implementation of scientifically enhanced tools for characterization and identification of genetic strings of aquaculture animals as well as for the development of related institutional issues.
- The development of advanced genetic techniques should continue, however their commercial application should be strictly controlled, and coupled with public education.
- The traditional European values in gene banking (salmon, common carp) should be further strengthened, and the increasing need for the conservation of genetic material of indigenous stocks should also be considered.
- The genetic improvement programs of commercially important species should be a joint effort by the government and private sector.

4.7. Feeds and feeding

- Together with the inevitable increasing of intensity level in European aquaculture production, the need for high quality formulated feeds will also increase in the future, but the availability of the feed ingredients presumably will not be a bottleneck of the development.
- There is a need however for the better exploitation and utilization of non-food grade fishery resources (by-catch and discards) in short term, and by-products of the terrestrial agricultural production sector (e.g. slaughterhouse wastes, plant oilseed and grain legume meals, cereal by-products) in long term as fish feed ingredients.
- The majority of the aquafeeds will be provided by centralized feed manufacturing companies, which will be able to supply improved feeds with minimized environmental impact, and knowledge-based services for the customers.
- The intensity level in a part of pond fish farms will also increase, wherever appropriate conditions are available. The principle of polyculture will be reconsidered, when species feeding low on the food chain will be used rather for water quality control during the intensive production of higher value species, which are fed on formulated feed.
- A considerable amount of fish ponds, especially in Central and Eastern Europe will be used for semi-intensive production of traditional species (mainly cyprinids) for local market, which production will be based on the utilization of agricultural by-products and cheap protein resources.

4.8. Fish health management

- Fish health management will continue to be a critical element of aquafarm management in Europe parallel to the projected increasing intensity level of aquaculture production.
- While there are effective protective measures against most of the bacterial and parasitic diseases, viral infections will continue to impose the largest threat to the aquaculture industry, which problem calls for further research in virology and the elaboration of correspondent vaccines.
- More emphasis should be given in the future to system management approach (SMA), which includes the health oriented farming environment and production technologies, fish health monitoring and sanitation along with advanced diagnostics, correct vaccination strategies and reliable quarantine measures.
- The network of national and EU reference laboratories should gradually be expanded all over Europe, in order to facilitate the use of standard diagnostic methods, with special regard to advanced techniques like FAT (fluorescent antibody technique), ELISA (enzyme linked immunosorbent assay), and PCR (polymerase chain reaction) especially for viruses.

- Although the application of system management approach will expectedly result in the decrease of drug use in aquafarming all over Europe similarly to the Norwegian salmon industry, the use of specific drugs and vaccines will continue for efficient disease prevention and treatment.
- Further research efforts, which require wide international cooperation, should focus on the development of system management approach, studies of the defense mechanisms in controlling aquatic animal diseases, development of vaccines and vaccination strategies, use of immunostimulants and non-specific immune-enhancers.
- The programs for prevention and control of diseases in European aquaculture will involve significant scope of regulatory activities related to establishing of internationally agreed severe quarantine regulations, standardizing of procedures related to health certification, and further development of support frame for wider implementation of disease eradication programs.

4.9. Water and environment management

- The scarcity of water will continue to increase in some inland areas of Europe, which is leading to tough competition among various water users. In coastal areas water quality problems became critical factors in aquaculture development. Aquaculture therefore should improve its image in the eyes of the policy makers and the public, in order to be equal right user of aquatic resources.
- Aquaculture development programs, independently from environment, production technology, species and intensity level, should be based more on appropriate strategies for water resources management. These strategies must encompass a range of aspects including social, economical and recreational considerations, as well as biodiversity and management issues of the wider environment.
- During the development of intensive land-based aquaculture production systems, water efficiency is a primary criterion, which could be achieved mainly by the recirculation of the water. The principle of recirculation will be applied not only to tank production systems, but also to pond fish farms in the future.
- New results of modern technologies should be applied during the development of coastal aquaculture in order to minimize environmental impact (off-shore cages, improved feeding technologies, controlled waste disposal, etc.).
- More emphasis should be given in the future to the development of integrated agriculture/aquaculture technologies, which allows the multiple use of water. The possibilities of other type of integration (e.g. with industry, water management, recreation) should also be better exploited in the future.
- However, commercial aquaculture and wetland management should be clearly separated. Where aquaculture is the primary activity, losses caused by external environmental impacts (e.g. birds) can not be tolerated, or not without compensation. Aquaculture however could also provide services (fish stocking, control harvest, etc.) to wetland management.

- Regular water quality monitoring will be an essential task for all aquafarms in the future. Water quality monitoring networks will be basic prerequisites of better water resources management both in river basins and coastal regions.

4.10. Aquaculture and information needs

- Considerable amount of information is available on European aquaculture, however, more emphasis should be given to the collation and assessment of this information, increasing user access to it, and where necessary, to its repackaging into more user friendly products.
- International organizations (FAO, FAO-EASTFISH, EU) will continue to have primary role to provide basic data and information. These organizations should also play leading role in the standardization of statistical data, which have not always been compatible and comparable.
- There will be an emerging importance of producer organizations to provide information to farmers with special regard to market and price information. The Federation of European Aquaculture Producers (FEAP) became an efficient forum for exchange of information among its 26 national associations from 20 countries.
- Those projects, which are aiming at the improvement of information flow through networking should further be supported and strengthened. An excellent example is the EU supported Aquaflow Project, which includes 17 countries (only one from former socialist countries). The involvement of Central and Eastern European countries in these networks should be stimulated and supported.
- Microcomputers are commonly used at many advanced farms in Europe for process control and data management, but in most of the farms computers are not used or only for accounting and word processing. Training and extension are needed in the future to demonstrate the benefits of information technology to farmers as well as providing the necessary technical support. At the same time, further development of specialized software for aquafarms is expected.

4.11. Assistance to policy development

- The critical features of aquaculture as a natural-resource based sector has been acknowledged within the EU, and during the expected further policy development and regulation, aquaculture will likely to play a more important part.
- In most of the European countries, where substantial aquaculture industries have been established over the past 20 years, explicit policies are in place for supporting aquaculture directly, and through research. There is a need however to realign policies regarding some increasingly important issues like sustainability, consumers demand, internationalization, innovation and integration.

- There is a need to strengthen aquaculture policy development in those European countries, where aquaculture does not have major importance in the national economy, or its potential has not been recognized, in order to consider aquaculture as an equal right user of resources.
- Policy development faces tremendous difficulties in Central and Eastern European countries, where dramatic changes have taken place in property rights, legislation, and institutional systems. In spite of the national efforts and international assistance (e.g. PHARE, TACIS, FAO, Know How Fund) to improve situation, the progress is very slow, however there are significant differences between countries. Considerable further efforts are needed to strengthen policy development in these countries.
- During policy development in European countries, special emphasis should be given to the harmonization of regulations with special regard to the forthcoming and later expansion of the EU.
- The role of international organizations, international federation of producers, and researchers is not negligible in the assistance of policy development, through the facilitation of communication in European level, the influence on policy makers and the education of the public.

4.12. Trade of aquaculture products

- There is a growing need to develop information systems, which distinguish the trade of wild and farmed products. The emerging producers associations and the Federation of European Aquaculture Producers (FEAP) started to establish databases on aquacultured products, which process should be encouraged and supported in the future.
- In spite of the substantial differences within the aquaculture sector in various regions of Europe, marketing problems found to be the major constraint in aquaculture development due to the increasing market competition, falling/stable prices and rising costs, and market restructuring throughout Europe. However, aquaculture products might continue to occupy an increasingly large part of the market for foods providing wide range of species and product form.
- Marketing problems constitutes major constraints in aquaculture development in Central and Eastern Europe, where the absorption capacity of local markets have been shrunk due to the decreasing purchasing power, and most of the products from these countries are not competitive on export markets. External assistance in aquaculture development therefore should focus on marketing in this region.
- Europe is an important market for a wide range of aquatic products from all over the world; however, the stagnation -and even decline- of the export of certain aquaculture products to Europe is projected mainly due to the regulations on product quality. However, the competition with the relatively cheap import products from outside of Europe still remains one of the constraints of further development of the European aquaculture sector.

- Fish consumption in Europe is static, but there is a great capacity to increase, through product diversification, added value processing, quality assurance schemes, branding and generic marketing. The emergence of “green consumers” and health conscious consumers may also support the increase of European aquaculture production.
- While export realities (like the imbalance trade with Asia for aquatic products) expectedly will not change significantly in the future, the availability of a large internal market for aquatic products, and the large scope for import replacement will be the main stimulus of aquaculture production in Europe.

4.13. Aquaculture and sustainable development

- Support for aquaculture has been largely focused on technical aspects of production, but ignored important linkages, including externalities, especially in the Central and Eastern European regions. Therefore, sustainable development is the overriding strategic issue in aquaculture, and will continue to be such in the foreseeable future.
- Governments need to create an “enabling” environment through appropriate policies and legal frameworks, which comprise economic, legal, social and physical components and ensure fair access to resources, mechanism for conflict resolution, and access to information, credit and market.
- The complex task at hand is to put the principles of the FAO Code of Conduct for Responsible Fisheries into operation, however balanced and informed approaches are required to address developmental and environmental issues effectively at any location.
- Long-term planning of integrated resources management requires good information, clear analysis and full communication between all parties involved, including NGOs, farmer associations, researchers, public officials, and media.

4.14. Financial assistance for aquaculture development

- Although aquaculture production is clearly a market-led business in developed countries of Europe, support measures by governments and international organizations should be available to assist sustainable aquaculture.
- Based on previous experiences with the Financial Instrument for Fisheries Guidance (FIFG) program in EU countries, grants should be available through realistic assessment of market opportunities. Soft loans may also be efficient support measures, however it should not distort normal competitive pressures. The measures for financial assistance should focus better on small and medium size enterprises (and also family, and part-time farming) in the future.
- The enlargement of the European Union to Central and Eastern Europe presents a historic opportunity for Europe to unite by peaceful means. The appropriate incorporation of aquaculture into the financial supporting instruments for accession countries (PHARE, SAPARD and ISPA) should be encouraged taking also into account the possible role of fish ponds in the alternative use of excess arable land areas.

- External technical and financial assistance is also needed to those Central and Eastern European countries, which suffer serious structural and economical difficulties. The FAO-EASTFISH Project, various EU projects (e.g. PHARE, or TACIS for the former USSR countries), World Bank, and other donor agencies should continue to provide assistance to these countries in order to develop the institutional system, knowledge base, infrastructure, and business opportunities in this region.
- Much of the growth of aquaculture production has been stimulated by science and technology, which require further support from national governments and international organizations. The Fifth Framework Program of the EU provides an appropriate framework for supporting research and technological development, in which sustainable agriculture, fisheries and forestry are among the priority areas. However, further financial resources, wide international collaboration among European countries, and integrated research and development strategies will all remain important issues in future aquaculture research.