

REGIONAL COMMISSION FOR FISHERIES

Report of the

**REGIONAL TECHNICAL WORKSHOP ON SUSTAINABLE MARINE
CAGE AQUACULTURE DEVELOPMENT**

Muscat, Sultanate of Oman, 25–26 January 2009



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ISBN 978-92-5-106224-1

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PREPARATION OF THIS DOCUMENT

This document is the final report of the Regional Commission for Fisheries (RECOFI) Regional Technical Workshop on Sustainable Marine Cage Aquaculture Development held from 25 to 26 January 2009 in Muscat, Sultanate of Oman. The document lists a series of suggestions and recommendations made by the experts that are considered important to further encourage and support the growth of the aquaculture sector in the region. It also contains the following three review papers prepared as background material for the workshop: 1) RECOFI country reports on marine cage aquaculture; 2) Regulation of Norwegian net-cage fish farming; and 3) Review on cage aquaculture licensing procedures: a focus on Chile, Greece, Spain and the United States of America.

This report was prepared by the WGA Secretariat and endorsed by the WGA.

ACKNOWLEDGEMENTS

Many thanks are due to the Ministry of Fisheries Wealth, Sultanate of Oman, particularly the Directorate General for Fisheries Research for the support and excellent hosting of the workshop.

FAO/Regional Commission for Fisheries.
Report of the Regional Technical Workshop on Sustainable Marine Cage Aquaculture Development. Muscat, Sultanate of Oman, 25–26 January 2009.
FAO Fisheries and Aquaculture Report. No. 892. Rome, FAO. 2009. 135p.

ABSTRACT

The Regional Commission for Fisheries (RECOFI) Regional Technical Workshop on Sustainable Marine Cage Aquaculture Development, held from 25 to 26 January 2009 in Muscat, Sultanate of Oman, was organized following the endorsement of the biannual work plan of the Working Group on Aquaculture (WGA) by the Commission at its fourth session (Jeddah, Kingdom of Saudi Arabia, 7–9 May 2007). The activity was endorsed in view of the growing importance and interest of this aquaculture sub-sector across the region. The workshop focus was on environmental impact assessment and monitoring, and aquaculture licensing for marine aquaculture cage systems. It also aimed at identifying constraints and shortcomings that needed to be dealt with to support the development of the cage industry and facilitate investments from the private sector. The document contains a set of suggestions and recommendations made by the experts with regard to technical and policy requirements needed to support the growth of the aquaculture sector as a whole and more specifically cage fish farming. RECOFI members have been encouraging cage aquaculture over the years, however, the current level of development varies considerably among the countries and, in general, cage aquaculture can only be considered an economic activity in its infant stages of development. The major constraints identified in the establishment of fish cages, particularly along the northwestern shores of the Gulf, have been the limited availability of suitable farming sites characterized by shallow waters, highly fluctuating salinity and temperature levels and inadequate sea currents. Other limitations included price competition from wild-caught fish, inadequate farming technologies for the region and the limited availability of endemic candidate species of commercial importance suitable for cage aquaculture. The report also contains three review documents on marine cage aquaculture in the region, regulation of Norwegian net-cage fish farming, and a review on cage aquaculture licensing procedures prepared as background discussion papers for the workshop. With specific regard to environmental impact assessment (EIA), the discussions held at the workshop clearly indicate that there is a need for the region and individual Commission members to develop an ad hoc EIA format based on the conditions of the local marine environment as this would determine the level of detail and elements needed to complete a meaningful and useful EIA study. The experts also agreed on the importance to establish regional Environmental Quality Standards (EQS) for fish farm sites in order to set the limits for maximum permissible impact on the area exploited by the cage farming industry and assist in establishing monitoring programmes. With regard to cage aquaculture licensing, the experts acknowledged that a clear licence system is required for exercising legal and administrative control over aquaculture operations as it confers different rights and obligations, and allows public control with regard to environmental protection and the economic sustainability of the farming practices. Furthermore, it was noted that the legislation involved and process in aquaculture licensing should be transparent, readily available and include information on processing time, payable fees, etc. A proposed cage aquaculture licence procedure was discussed and proposed at the workshop based on the format developed and adopted by the Sultanate of Oman. Other matters discussed at the workshop included the occurrence of hazardous algal blooms in the Gulf and its effects on fish farming and the possibility of establishing a regional fish cage farm for demonstration, research and training purposes.

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BACKGROUND

1. During the fourth session of the Regional Commission for Fisheries (RECOFI), held from 7 to 9 May 2007 in Jeddah, Kingdom of Saudi Arabia, the Commission endorsed the organization of the “Regional technical workshop on sustainable marine cage aquaculture development” as a priority activity to be included in the biannual work plan of the Working Group on Aquaculture (WGA). The activity was endorsed in view of the growing interest of this aquaculture sub-sector across the region and the strong support of the RECOFI governments in promoting the development of aquaculture.

2. In view of the overall regional concern on the protection of the marine environment and its resources it was agreed that the workshop would initially focus on issues related to site selection, environmental impact assessment and monitoring, and licensing specific to finfish cage aquaculture. The aim of the activity is for the region to develop specific and standardized protocols and procedures related to the aforementioned issues which could be adapted to national needs and conditions, if required, and incorporated in the regulatory framework governing the development of the aquaculture sector.

3. The preparatory work for the workshop included the submission of national reviews on marine cage farming in the region prepared according to an agreed content format. The terms of reference used for the preparation of the review are outlined in Appendix E. Such reports provide an insight on the current status of the industry and the technical and policy-related constraints challenging cage mariculture. They also highlight the different developmental potential among the countries in the region. Two background documents which include a case study on the regulations governing Norwegian cage fish farming, with specific emphasis on environmental impact assessment and monitoring procedures, and a review document on cage aquaculture licensing procedures were also commissioned.

4. This report documents the outputs of the RECOFI-WGA Regional technical workshop on sustainable marine cage aquaculture development held from 25 to 26 January 2009 at the Safer International Hotel, Muscat, Sultanate of Oman.

OPENING OF THE WORKSHOP

5. Mr Saoud Hamood Al-Habsi, Director General, Directorate General for Fisheries Research of the Ministry of Fisheries Wealth, Sultanate of Oman, officially opened the workshop and welcomed all participants. In his opening address, he recalled that the WGA was established by the Commission in recognition of the growing importance of aquaculture at both global and regional levels. He underlined that the support granted to the WGA by its member countries reflected the common understanding that for the sector to grow sustainably and competitively there is a need to strengthen communication in the region. He anticipated that such cooperation will continue in the future. Mr Al-Habsi highlighted a number of positive developments and activities that have taken place since the establishment of the Working Group such as the establishment of the Regional Aquaculture Information System (RAIS) and the launching of the project on strengthening the aquaculture legal and policy framework in the RECOFI region. He further mentioned that Oman strongly supports the development of the aquaculture industry and is in the process of expanding its research facilities and focus on capacity building. He invited all member countries to effectively coordinate their applied research activities, particularly in the identification of endemic aquaculture candidate species and farming technology development. He finally expressed his

satisfaction with the WGA for organizing the workshop, in particular to the emphasis given to environment protection and monitoring, and thanked the WGA Focal Points, the Secretariat and the Organizing Committee of the Ministry of Fisheries Wealth for their work and support. The text of the opening speech, in English and Arabic, is attached to this report (Appendix C.)

6. The WGA Chairperson, Mr Dawood Suleiman Al-Yahyai, also welcomed participants from the RECOFI members and resource experts and, on behalf of the authorities in Oman, expressed his pleasure in hosting this technical workshop. He expressed his regret that the delegation of the Islamic Republic of Iran was unable to attend the meeting, due to internal administrative issues, as was the case for the previous workshop on aquatic animal health held in Jeddah, Kingdom of Saudi Arabia, from 6 to 10 April 2008. He conveyed his good wishes for a productive workshop and looked forward to concrete results that would assist the concerned authorities in supporting the development of cage farming in the region and provide guidance for future work to be undertaken by the WGA.

7. Mr Alessandro Lovatelli, Fishery Resources Officer (Aquaculture), Aquaculture Management and Conservation Service (FIMA), Food and Agriculture Organization of the United Nations (FAO), and RECOFI-WGA Technical Secretary, welcomed the participants and gave brief background details with regard to the workshop following the outcomes and recommendations made at the third meeting of the WGA held in Jeddah, Kingdom of Saudi Arabia, from 7 to 9 May 2007.¹

ADOPTION OF THE AGENDA

8. The WGA Chairperson introduced the provisional annotated agenda and reminded participants that the workshop, endorsed by the Commission at its last session (Jeddah, Kingdom of Saudi Arabia, 7–9 May 2007), aimed at identifying specific activities required to accomplish the objective of developing regional standard protocol formats for cage fish farming environmental impact assessment, environmental monitoring and licensing procedures. The agenda shown in Appendix A, was adopted, without changes, by the WGA.

WORKSHOP PARTICIPATION

9. The workshop was attended by experts from seven members of the Commission with a total of 31 participants including selected WGA Focal Points and Alternate Focal Points (Bahrain, Iraq, Oman, Qatar, Saudi Arabia, and the United Arab Emirates), scientists and researchers from the Ministry of Fisheries Wealth and Sultan Qaboos University, Oman, members of the private sector (Asmak Quriyat International LLC, Oman), a representative from the Fish Farming Centre in Jeddah, Saudi Arabia, and members of the Secretariat. The list of participants is provided in Appendix B to this report.

CAGE AQUACULTURE IN THE RECOFI AREA

10. The Secretariat presented an overview of the current status of marine cage aquaculture development in the region based on seven country reports submitted by the WGA Focal Points. The presentation, along with additional information shared by the experts attending the workshop, provided a clear picture on the status of cage culture in the region and the

¹ For details refer to Appendix E of the Report of the fourth session of the Regional Commission for Fisheries. Jeddah, Kingdom of Saudi Arabia, 7–9 May 2007. *FAO Fisheries Report*. No. 847. Rome, FAO. 2007. 46p. Also available at: <ftp://ftp.fao.org/docrep/fao/010/a1628b/a1628b00.pdf> (English and Arabic versions).

technical, physical and policy constraints currently faced by individual member countries in supporting the further development of the sector. The RECOFI country reports on marine cage aquaculture are reproduced in Appendix F.

11. The RECOFI members have, over the years, been encouraging cage aquaculture, however, the current level of development varies considerably among the countries and, in general, cage aquaculture can only be considered as an economic activity in its early stages of development. Experimental cage culture trials have been carried out by various research institutions in the region (e.g. Bahrain, Kuwait and Oman) however, in some countries, this has not attracted much attention or interest from the private sector.

12. The major constraint identified in the establishment of fish cages, particularly along the northwestern shores of the Gulf, has been the limited availability of suitable farming sites characterized by shallow waters, highly fluctuating salinity and temperature levels and inadequate sea currents. Other limitations identified by the experts included price competition from wild-caught fish, inadequate farming technologies for the region (i.e. introduction and poor adaptation of existing technologies used elsewhere), and the limited availability of endemic candidate species of commercial importance suitable for cage aquaculture (many existing operations currently farm the gilthead seabream, *Sparus aurata*, and the European seabass, *Dicentrarchus labrax*, voluntarily introduced from the Mediterranean Sea).

13. The issue of seed supply of commercial finfish species was also recognized as hampering the growth of the sector with only few existing hatcheries mainly operated by the public sector (e.g. Bahrain). Applied research in the region, with regards to developing hatchery technologies for valuable local species, has been ongoing for several decades however to-date only one commercial marine species is effectively mass produced in the region for cage aquaculture and restocking programmes, i.e. the Sobaity seabream (*Sparidentex hasta*). Work on other important market species has been ongoing and includes several species of groupers (e.g. the orange-spotted grouper, *Epinephelus coioides*), the yellowfin seabream (*Acanthopagrus latus*), and the mangrove snapper (*Lutjanus argentimaculatus*). Further research, however, is required to refine such hatchery technologies in order to ensure the production of large quantities of these species.

14. From an institutional point of view the experts acknowledged that not all countries in the region had progressed with developing targeted policy frameworks, rules and regulation to adequately encourage the private sector to invest in cage culture. In fact, many countries in the region lack in-depth regulations focused on governing cage aquaculture, from licensing procedures, environmental impact assessment and monitoring requirements, to site selection procedures, although a number of government incentives are currently in place (including soft loans and subsidies). It was further recognized that in some of the RECOFI countries, where environmental impact assessment regulations exist, these are not tailored for cage aquaculture.

15. In view of the different physical characteristics of the shoreline in the region, it was accepted that the potential for developing a significant cage culture industry may differ between the countries; however, this was very much dependent on the development of suitable farming structures and identification of candidate species. Finally, in view of competing resource users for the coastal areas (e.g. tourism, nature conservation, property development, shipping, petroleum industry and defence), the experts suggested that proper site identification and aquaculture zoning may help reduce conflicts of interest among the

different and potential users of the coastal and marine environment. In order to provide an example of such, participants from Oman cited a case where a number of commercial cage farming applications have been submitted by the private sector but the licences have still to be granted due to administrative delays from other authorities with a jurisdiction on coastal resources.

16. The workshop participants recognized that the potential for cage farming development among the member countries may differ however fully agreed that there is a strong need to develop common environmental protocols (which include the introduction of exotic species) considering that the region shares the same water body.

17. With regards to site selection and identification of suitable areas for fish cage farming in the region, the workshop participants recognized that adequate information on the local natural environment (current conditions and water renewal, tidal ranges, sediment and habitat types, water column depths, seabed topography, salinity and temperature ranges, etc.) and on the occurrence of various environmental conditions such as hyper-nutrication, eutrophication, incidences of red tides, and potential impacts of cages on the seabed, is essential. It was agreed that much of this information is stored and available in reports and databases, however, the experts raised some concern that some of this information might be difficult to access particularly by the private sector. It was therefore recommended that the relevant environmental data be collected, compiled and provided in an accessible form along with information on site selection criteria and area availability for cage fish farming.

18. The experts noted that recommending and finding suitable sites for cage aquaculture in the region has been and will be a challenge for the authorities and the industry. It was agreed that although coastal zoning, through the use of appropriate spatial tools, can be a time consuming and resource demanding process it would allow for the identification and allocation of specific geographical areas to aquaculture practices and hence simplifying the process of farm site selection and subsequent environmental impact assessment requirements. It was strongly recommended that the issue of aquaculture zoning should be taken up at the national level, particularly by those countries in the region that have limited natural resources which are in high demand by competing users. The experts proposed that the WGA should consider including in its next work plan an activity to review the regional competence in the use of spatial planning tools and organize an inception workshop that would synthesize the knowledge acquired in the region and to recommend a road map on how to move forward.

CAGE AQUACULTURE – ENVIRONMENTAL IMPACT AND MONITORING

19. A presentation on the regulation of the Norwegian marine cage aquaculture industry was delivered by Ms Pia Kupka Hansen, a scientist at the Institute of Marine Research (IMR), located in the coastal city of Bergen, Norway (www.imr.no/english/). She presented the developmental events of the Norwegian cage aquaculture industry highlighting the various technical and legal issues which have been dealt with and adjusted over the years. The main elements that should be taken into account to support the sustainable development of a marine fish cage farming industry were also presented and discussed. The complete review and background paper is attached to this report as Appendix G.

20. Ms Hansen in her presentation indicated that parallel to the growth of the Norwegian fish farming industry there has been a development in legislation and regulations covering all aspects of production, as well as management plans and monitoring processes for the control

of diseases and environmental problems. With regard to the Norwegian aquaculture licence she indicated that this legal document comprises a set of rights and obligations. The applications for an aquaculture licence and a farm site have been integrated into a single application form and are issued for a given species and for a maximum allowable production biomass. The application is submitted to the Directorate of Fisheries which is the main authority responsible for processing the application and for coordinating its clearance with other competent authorities (environmental and veterinary authorities), hence streamlining the approval or rejection process.

21. The procedures and contents of an EIA and site selection criteria were raised and discussed extensively, particularly as some countries in the region require a mandatory EIA prior to establishing a cage operation. It was noted that the existing protocols have not been specifically designed for cage aquaculture projects. The experts acknowledged that the literature provides numerous EIA examples, but there is a need for the region and individual Commission members to develop an ad hoc format based on the conditions of the local marine environment as this would determine the level of detail and elements needed to complete a thorough and useful EIA study.

22. Following discussions with the consultants, the contents of an EIA format were developed and are attached hereto as Appendix H. The format presented embraces a more comprehensive set-up than what was dealt with, but includes all of the elements discussed at the workshop. This will enable the individual countries to adapt the format to the national regulations and needs by selecting those elements of relevance. It was however emphasized that the contents of the EIA must not be regarded as complete as elements can be added or omitted depending on the local circumstances. In order to adapt an EIA format, it was further agreed that an inventory of relevant habitats in the individual countries and knowledge of the natural oceanographic and topographic conditions were prerequisites for drawing-up a detailed protocol and for understanding where to perform specific investigations.

23. The socio-economic aspects of an EIA were not discussed to the same extent as the impact on the natural environment, however it was recognized that specific procedures for stakeholder participation and screening already existed. The possible impact of aquaculture development on fishing community activities was emphasized by the group.

24. The workshop participants also recognized the need to adequately train technobureaucrats in dealing and properly interpreting the results of an EIA study.

25. The environmental impact assessment process is incorporated in the licensing procedures and, based on the information provided by the applicant, the decision-makers identify and predict the potential impact of the fish farm on the environment. The application process is intended and designed to facilitate proper site selection and preferably to identify a site that can be exploited over a long period. Following the issuance of a licence and allocation of a site, farmers must observe the regulations, standards and monitoring plans.

26. Monitoring immediately under the seabed and in proximity of a fish farm is mandatory in Norway, however monitoring of a larger area may also be required by the authorities. Monitoring is performed in accordance with the Norwegian Standard NS9410, which provides detailed procedures on how the environmental impacts of individual fish farm sites should be monitored. Environmental Quality Standards (EQS) for fish farm sites and surrounding areas have been set-up such a way that farm sites may remain in use over a long

period of time. They also aim at ensuring that the farmed fish have favourable living conditions and prevent an unacceptable impact on the surrounding area. The EQS sets a limit for maximum permissible impact and makes it possible to distinguish between various impact levels. Apart from the monitoring of the seabed, the authorities may also require monitoring to be carried out before a farm is effectively established, during its operation and after the site has been abandoned.

27. The participants also indicated the need to obtain detailed information on how to monitor cage fish farms with regard to both their benthic and pelagic impacts. It was suggested that monitoring programmes from other cage culture farming countries be used however these need to be adapted to local conditions. A monitoring programme consists of a number of parameters to be measured, but also specifies how, where and how often samples should be taken and analysed. Furthermore, the importance of monitoring results against threshold impact limits (EQS) was emphasized.

28. Monitoring should be performed by trained personnel who should preferably possess some form of certification, and the authorities responsible for evaluating the monitoring, must themselves be given adequate training. An example of a monitoring programme for net cage fish farming is referred to in the Norwegian report attached as Appendix G.

29. In order to develop and establish a standard and specific fish cage culture monitoring protocol in the region it was recommended that one or more marine biology postgraduates from the RECOFI countries be responsible for the adaptation of an existing monitoring programme and EQS by establishing contacts with a research institute that holds expertise in cage farming impact and monitoring. In this regard, the experts invited the Secretariat to seek the possibility of organizing such know-how transfer through a dedicated training activity in Norway or an alternative country which has developed an adequate and functional fish cage aquaculture monitoring programme. The proposed activity would ensure the quick and easy transfer of expertise which would allow the selected biologists, in collaboration with the foreign partner, to adapt the monitoring programmes and EQS to local conditions. The trained staff would initially perform all monitoring in the region and subsequently train local technicians to take over as well as train officials from competent authorities to read and understand the scientific information contained in an EIA and the results of the monitoring process.

CAGE AQUACULTURE – LICENSING

30. The WGA Technical Secretary introduced the agenda item on cage aquaculture licensing based on a review document commissioned to Ms Rosa Chapela Pérez, an aquaculture legal expert with the Fisheries Socio-economics Department of the Technological Centre for the Sea (or Centro Tecnológico del Mar – CETMAR; www.cetmar.org/en/) of the Government of Galicia, Vigo, Spain. The paper on the “Review on cage aquaculture licensing procedures: a focus on Chile, Greece, Norway, Spain and the United States of America” is attached to this report as Appendix I.

31. The paper presents an overview of the policy and legal framework governing aquaculture in five countries which have an established cage aquaculture industry and focuses on licensing systems and permit procedures and requirements. The document outlines the number of different national agencies and local authorities typically involved in the management and regulation of the aquaculture sector including the granting of a farming

licence. The need to streamline and simplify the licensing process to encourage and facilitate investment is strongly highlighted. With specific regard to the farm licence, the rights and the duties of an aquaculture licence holder are discussed in details and are underlined as crucial elements in protecting the interest of the investor. Furthermore, the clear specification of the licence duties will ensure, among others, that the environmental obligations of the licence holder are met and maintained during the implementation and operation of a fish farm.

32. The review document indicates that aquaculture as a whole is frequently poorly regulated with many existing legislations not specifically issued for the industry. The often complex system for granting a farming permission, the excessive bureaucracy through the involvement of numerous and typically poorly coordinated competent authorities, and the general exclusion of aquaculture as an economic activity and potential resource user in coastal zone planning exercises are cited among the regulation constraints affecting the industry. The review clearly indicates that there is a general need and demand from the private sector to improve current aquaculture legislation also in those countries where the sector is flourishing.

33. Specific to aquaculture licence procedures the document lists the following as some of the main problems: i) lack of juridical safety, time-consuming and excessively long periods required to follow-up legal measures and hence the need for more transparent and faster license application procedures; ii) the need to establish specific procedures for different aquaculture operations (e.g. inland aquaculture, offshore); iii) call for clear environmental measures not subject to changes under different administrations; iv) simplification and harmonization of aquaculture legislation among the different agencies involved; and vi) the often unclear role played by different agencies involved in the licence process.

34. The experts acknowledged that the licence system is the most widely used technique for exercising legal and administrative control over aquaculture operations as it confers different rights and obligations, and allows public control with regard to environmental protection and the economic sustainability of the farming practices. Licence conditions are used as a regulatory tool to control the operation and ensure that aquaculture activities are developed in accordance with national laws and regulations and into a plan or specific site.

35. The workshop participants discussed the licence application process outlined in the review paper and those currently adopted in selected countries in the region. It was agreed that potential investors require access to different types of information in order to adequately complete and submit an application form as well as a clear understanding of the application procedures. Furthermore, it was agreed that the legislation involved and process in aquaculture licensing should be transparent, readily available and include information on processing time (preferably providing an indication on time limits), payable fees, if any, and whether there is a need for financial coverage in order to ensure that a site is cleared and cleaned in the event of bankruptcy. It was suggested that the countries in the region should prepare an instruction guide on how to complete a licence application. Such a guide should list all the documents to be presented to the competent authority along with the application. In this regard it was agreed that the Secretariat would make available to the WGA the guide used in Norway, once an English version of the document becomes available. This document would be used as an example to develop a regional guide that could in turn be adapted to national needs.

36. The experts attending the meeting also agreed that potential aquaculture investors in the region should be informed on what information is advisable to collect prior to applying for

a farm licence for a specific site. It was concurred that the advance availability of this pre-application data and information would certainly facilitate the issuance process of a licence and subsequent conduct of a follow-up EIA, if required by law. Furthermore, this simplified feasibility study would very likely reduce pre-investment expenses by ensuring that an investor targets a site that has a good basis for a successful application process. The experts also recognized that where coastal developmental plans or aquaculture zoning exist, individual licence applications could be considerably less complex as prospective developers would be able to access considerable information from these plans and would not have to seek the agreements and permissions from the concerned national and local authorities involved in the process. Appendix J lists the type of data and information needed and recommended by the workshop participants prior to the submission of a licence application.

37. A proposed cage aquaculture licence procedure was discussed and developed at the workshop based on the format developed and adopted by Oman. The proposed procedure is attached as Appendix K to this report.

OTHER MATTERS

Review on environmental impact assessment and monitoring in aquaculture

38. The WGA Technical Secretary informed the workshop participants on the FAO project on “Environmental Impact Assessment and Monitoring in Aquaculture” currently under implementation by the Aquaculture Management and Conservation Service (FIMA). He informed that this project aims to address key issues of environmental assessment and monitoring in aquaculture with a view to generate strategic advice and technical guidance information for use in policy making, capacity-building and training in the sector. Special attention is given to different aquaculture farming systems, different environments and different socio-economic contexts of development, with particular consideration of special circumstances and requirements of developing countries.

39. Through the project, case studies were prepared to cover the compilation and review of existing EIA and environmental monitoring procedures and practices in aquaculture in selected countries of the following regions Africa, Asia-Pacific, Europe and North America, and Latin America. A fifth special case study focused on EIA in marine cage aquaculture of salmon in Canada, Chile, Ireland, New Zealand, Norway, United Kingdom and the United States of America. A global review and synthesis report was also prepared based on these four regional case studies and the salmon aquaculture study.

40. In order to analyze and discuss the above regional reviews and global synthesis, an FAO Technical workshop on environmental impact assessment and monitoring in aquaculture was held in Rome from 15 to 17 September 2008. The workshop produced a range of conclusions, recommendations and elements for guidelines on EIA procedures, monitoring and environmental management frameworks relevant to aquaculture. The workshop report, as well as the thematic reviews, will be available as an FAO Fisheries and Aquaculture Technical Paper by April 2009. The draft table of contents of this paper was presented. It was further agreed that this document would be good reference material for the region.

Algal blooms and cage aquaculture

41. The damage resulting from algal blooms and more specifically from red tides to fish farming was raised by the experts attending the workshop. It was reported that the industry in the region had recently suffered a serious setback due to a major red tide event that killed the entire fish stocks in fish cages off the coast of Oman and the United Arab Emirates.

42. Algal blooms are natural phenomena that occur in the Gulf waters when the conditions are favourable. Factors that trigger such events include temperature levels and the nutrient content of the water. The question raised by the participants was how to tackle the problem and protect and prevent disasters in the mariculture industry. It was generally agreed that there is a need to develop the ability to anticipate such events, monitor water conditions, establish warning procedures and develop contingency plans.

43. The experts recommended that the WGA should consider organizing a technical workshop on the impact of hazardous algae on aquaculture with a focus on how the cage culture sector should handle the problem by developing suitable counter measures in the event of a hazardous bloom. Topics suggested for the workshop would include an introduction to algae biology, information on common blooms, species identification, conditions and mechanisms involved in triggering the blooms, effects of the blooms on caged fish, monitoring programmes, establishing warning systems and contingency plans, countermeasures and remedy actions, lessons learned, existing best management practice and the role of governmental agencies. In this regard the experts acknowledged the work carried out by Oman in the preparation of best management practices related to local cage aquaculture and invited the relevant authority to share and distribute the document when completed and available.

44. It was also recommended that the proposed workshop should be coordinated with the agenda of the Regional Organization for the Protection of the Marine Environment (ROPME; www.ropme.org) in view of the mandate of this regional organization. The red tide workshop organized by ROPME, held in the United Arab Emirates in November 2008, was referred to by the experts.

Fish cage demonstration farm

45. In view of the current developmental stage of fish cage farming in the region the workshop participants suggested that the establishment of a commercial demonstration cage farm would greatly enhance the opportunities to gain and share the much-needed experience not only in the operation of the farm, but would also provide an opportunity to the authorities to evaluate the suitability of their regulations and procedures.

46. The demonstration farm would allow the testing of environmental impact and monitoring procedures, performance and follow-up of monitoring programmes, adapting procedures to the individual cultured species, improving husbandry procedures (including disease treatment, handling of dead fish and waste), demonstrating the need for enforcement, and making indirect tests of the regulations. Observing the operations and scrutinizing the results of the ongoing tests would enable procedures to be streamlined and improve practical skills in carrying out farming and environmental monitoring operations.

47. It was also agreed that the farm could serve as a training centre for fish farmers, consultants and representatives of the authorities that deal with the processing of licences, environmental impact assessment and monitoring procedures and their enforcement. The option of using existing farming facilities was suggested and should be investigated. It was further recommended that the region should encourage information exchange between existing research facilities (including universities) and develop joint research cooperation programmes.

RECOFI-WGA legal aquaculture project proposal

48. The experts attending the workshop recognized the importance in implementing the legal and aquaculture project, prepared by the WGA and endorsed by the Commission at its fourth session (Jeddah, Kingdom of Saudi Arabia, 7–9 May 2007), as it would also cover issues related to aquaculture licensing and mandatory EIA and monitoring programmes. The participants invited the WGA to raise the issue at the next session of the Commission planned to take place from 12 to 14 May 2009 in Dubai, United Arab Emirates.

CLOSING REMARKS AND ADOPTION OF THE REPORT

49. The workshop participants acknowledged that the cage culture industry is still in an infancy stage and agreed that the governments in the region will play an important role in the future development and promotion of this farming practice as well as aquaculture as a whole. The development of adequate aquaculture frameworks, targeted rules and regulation including clear procedures on environmental requirements and farm licensing will certainly encourage investment in the region.

50. On behalf of the workshop participants, the Chairperson of the RECOFI-WGA, Mr Dawood Suleiman Al-Yahyai, expressed his appreciation to the Secretariat for organizing this technical workshop and invited all RECOFI-WGA focal points to circulate and discuss the workshop report and recommendations with the relevant national authorities in order to ensure a fruitful discussion during the next RECOFI session scheduled to take place in the United Arab Emirates in May 2009.

51. The report of the workshop was approved and adopted by the participants including the list of the workshop suggestions and recommendations attached as Appendix D.

Workshop agenda


**REGIONAL COMMISSION FOR FISHERIES
(RECOFI)**


REGIONAL COMMISSION FOR FISHERIES (RECOFI)
Working Group on Aquaculture (WGA)
Regional technical workshop on sustainable marine cage aquaculture development
Muscat, Sultanate of Oman, 25–26 January 2009
AGENDA

Saturday, 24 January 2009

Arrival of workshop participants. Informal hotel lobby meeting at 20:30

Sunday, 25 January 2009

08:30-10:30	Opening of the workshop
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1. Registration
2. Introduction of workshop participants and consultants
3. Adoption of the provisional annotated agenda
4. Introduction to the scope of the workshop and expected outputs
5. Regional review: Marine cage culture in the RECOFI region

10:45-17:15	Marine cage aquaculture – Environmental impact and monitoring
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The discussions at the technical workshop will be facilitated and coordinated by Dr Håkon Kryvi on the local situation, needs and priorities in the region with regards to cage culture development and particularly on environmental impact assessment/monitoring and farm licensing. Dr Kryvi is currently a senior adviser to the Norwegian state pollution control authority on environmental impact of aquaculture and coastal zone management. He has long management experience dealing with all environmental concerns from cage aquaculture in Norway. He was also responsible for the marine component of a comprehensive project launched to develop a tool for aquaculture planning and suitability assessments in Norway with regards to site selection, environmental impacts, monitoring and a wide range of relevant issues and concerns for aquaculture production.

1. *Presentation on fish cage culture in Norway - A case study*

A presentation on the regulation of the Norwegian marine finfish aquaculture industry will be delivered by the FAO consultant, Ms Pia Kupka Hansen, working as senior scientist at the

Institute of Marine Research, Bergen, Norway. The developmental events of the Norwegian finfish cage aquaculture industry will be presented in a chronological order from its early stages to its current status. The presentation will highlight how various technical and legal issues have been dealt with and adjusted over the years. The main elements that should be taken into account by technocrats in supporting the sustainable development of a marine fish cage farming industry will be presented and discussed.

Agenda objective: The presentation above aims at opening the discussion among the participants attending the workshop. The aim is to identify the needs and priorities in the RECOFI countries and in the region as a whole with regards to cage culture environmental impact assessment (EIA), environmental monitoring, site selection, etc. The group will be requested to identify the need for specific and focused activities required to develop and harmonize regional standards and protocols.

Monday, 26 January 2009

09:00-17:15	Marine cage aquaculture – Licensing
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1. *Presentation of a review on cage aquaculture licensing procedures*

A review on cage aquaculture licensing procedures indicating the general principles and guidelines involved in establishing a cage culture farm will be presented. The review will draw from the current regulations in place in selected countries where cage aquaculture is an important economic activity (e.g. Spain, Norway, Greece, Chile and the United States of America). The review aims at showing examples of best practices aim at helping the government with policy options for better governing of marine aquaculture and recommendations for a legal framework in terms of aquaculture permitting.

Agenda objective: The aim is to identify the needs and priorities in the RECOFI countries and in the region as a whole with regards to marine cage culture licensing procedures. The group will be requested to identify the need for specific and focused activities required to develop and harmonize regional protocol.

2. *Workshop summary and findings*

A workshop summary will present the main issues and points discussed by the participants. Based on these the workshop consultants will identify specific and focused activities required as follow-up actions needed to reach the objectives of developing the targeted cage aquaculture protocols for the region. A number of brief project concept notes describing the issue and inputs required, will be prepared following the workshop. The project briefs produced will be presented and prioritized during the fourth WGA meeting for inclusion in the next work plan proposal for discussion ant the fifth session of the Commission that will take place in May 2009.

Agenda objective: To identify and prioritize follow-up activities.

Coffee and lunch breaks

Throughout the workshop there will be the following breaks. The tentative timings are given below:

Morning break	– 15 minutes	– Starting at 10:30
Lunch break	– 1.5 hours	– Starting at 12:30
Afternoon break	– 15 minutes	– Starting at 15:30

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Opening speech

by

Saoud Hamood Al-Habsi
Director General for Fisheries Research
Ministry of Fisheries Wealth
Sultanate of Oman

Honourable delegates and guests,

A'Salaam Alikumm.

It is my pleasure to welcome you at the opening of the “Regional technical workshop on sustainable marine cage aquaculture development” organized by Working Group on Aquaculture of the Regional Commission of Fisheries (RECOFI) in collaboration with our Ministry of Fisheries Wealth which will be held here in Muscat from 25 to 26 January 2009. I also take this opportunity to convey the warm greetings and wishes for a successful meeting from H.E. Mohammed bin Abdulla Al-Qatabi, Minister of Fisheries Wealth and H.E. Dr Hamad Al-Oufi, Undersecretary of Ministry of Fisheries Wealth.

The aquaculture sector is recognized as an important and expanding economic sector which provides food, income and an increasing number of job opportunities. RECOFI member countries also realize its importance and have started to develop and invest into this sector in a sustainable manner. As a result the RECOFI Working Group on Aquaculture was established to play a vital role in increasing communication and cooperation among the countries in and outside the region.

Since the official establishment of the WGA during the second session of Commission held in Muscat in 2003, the WGA has held numerous technical meetings and workshops. Among these, endorsed by the Commission, I wish to mention the establishment of the Regional Aquaculture Information System (RAIS) which will be officially launched before the next session of the Commission and the project on strengthening the aquaculture legal and policy framework in the RECOFI area.

The Ministry of Fisheries Wealth strongly supports the development of aquaculture in the Sultanate of Oman and as a result established the Fisheries and Aquaculture Centre to provide the technical inputs and knowledge required to properly develop and support the sector. The Centre is growing in terms of facilities and expertise, nevertheless runs an active applied research programme focused on local needs and supervises a number of priority projects. The Centre also plays an active role in dissemination current and new farming technologies and contributes significantly towards public awareness on the potential and importance of this sector. One of the main research programmes coordinated by the Centre is the identification and selection of suitable endemic species as aquaculture candidates and development of appropriate and environmental friendly farming technologies.

This important workshop will focus on the potential for cage aquaculture in the RECOFI marine waters and eventually aims at recommending on how best this farming technology should be promoted and development with regards to the safeguarding of the marine environment. The development of standard and regional protocols on environmental assessment and monitoring, licensing procedures and best management practices will certainly contribute positively to the growth of this sector.

Finally, we take this opportunity to express our sincere gratitude to all the participants from the RECOFI members, invited experts and the FAO Secretariat for organizing and holding this meeting. I wish also to thank the Organizing Committee of the Ministry of Fisheries Wealth for their support.

A'Salaam Alikumm.

الاجتماع الرابع لمجموعة عمل الاستزراع السمكي التابعة للريكوفي

الحمد لله رب العالمين ... والصلاة والسلام على أشرف المرسلين سيدنا محمد (صلى الله عليه وسلم) وعلى آله وصحبه أجمعين...

ضيوفنا الكرام ...

السلام عليكم ورحمة الله وبركاته،،،

يسعدني ويشرفني أن نرحب بكم في افتتاح الورشة الخاصة بتطوير استزراع الأقفاص العائمة والاجتماع الرابع لمجموعة عمل الاستزراع السمكي التابعة للهيئة الإقليمية لمصايد الأسماك (للريكوفي) خلال الفترة من 25-28/يناير لعام 2009م بمسقط. ونغتنم هذه الفرصة لننقل لكم تحيات معالي الشيخ/ محمد بن عبدالله القتيبي - وزير الثروة السمكية وسعادة الوكيل/ حمد بن سعيد العوفي ودعمهما وتمنياتهما لهذه الورشة بالنجاح والتوفيق.

الحضور الكريم،،،

يعتبر قطاع الاستزراع من أهم القطاعات الحديثة التي من شأنها توفير الغذاء وفرص عمل جديدة. وتدرك الدول الأعضاء التابعة للهيئة الإقليمية لمصايد الأسماك (ريكوفي) هذه الأهمية وبدأت قدما في تولية هذا القطاع أهمية عظمى وبطريقة مستدامة. ولعل خير دليل على اهتمام الدول الأعضاء هو المشاركة في تأسيس مجموعة العمل الخاصة بالاستزراع السمكي لتقوم بدور حيوي وفعال لتعزيز التعاون بين الدول في مجال الاستزراع.

ومنذ التأسيس الرسمي للمجموعة والذي تم خلال الاجتماع الثاني لريكوفي في مسقط لعام 2003م، قامت المجموعة بعقد عدة اجتماعات وحلقات فنية. كما تم إعداد عدد من المشاريع من قبل المجموعة تتمثل في:

- (1) تأسيس نظام المعلومات الخاص بالاستزراع RAIS.
- (2) مشروع تقوية النظم التنظيمية وسياسات الاستزراع في منطقة ريكوفي.

وقد أدركت وزارة الثروة السمكية أهمية هذا القطاع في السلطنة. وفي ضوء ذلك تم إنشاء مركز الاستزراع السمكي في لمواكبة التطور المتوقع في قطاع الاستزراع السمكي. ويقوم المركز بالبحوث اللازمة لتطوير هذا القطاع. كما يقوم بعملية مراقبة مشاريع الاستزراع السمكي ونشر التقنيات الحديثة في وتوعية المجتمع بأهمية الاستزراع السمكي. ومن أهم الأبحاث التي يقوم بها المركز اختيار الأنواع المحلية من الكائنات البحرية القابلة للاستزراع .

ولعل تقنية الاستزراع باستخدام الأقفاص العائمة من مجالات الاستزراع الرائدة في المنطقة مما يتطلب العمل معاً من أجل التخطيط لتطويرها بطريقة مستدامة ودراسة التحديات والمخاطر التي تواجه هذه التقنية مثل المد الأحمر . ومن خلال استضافتنا لهذه الورشة، فإننا على ثقة تامة بأن مخرجات هذه الحلقة من شأنها المساهمة في تقديم المساعدة للدول الأعضاء لتطوير هذا المجال أملين منكم إثراء مناقشات هذا اللقاء وتقديم التوصيات والمقترحات التي من شأنها إرشادنا إلى التطوير المستدام للاستزراع في الدول الأعضاء التابعة للهيئة.

والجدير بالذكر أن الهدف من هذه الورشة يتمثل في دراسة وضع الاستزراع البحري في الدول الأعضاء وذلك من خلال استعراض التقارير الخاصة بكل دولة. إننا نجتمع هاهنا لنصل إلى المقترحات والتوصيات المتعلقة بالمواضيع التالية:

- التشريعات التنظيمية والمؤسسية الخاصة بالاستزراع البحري بالأقفاص العائمة.
- الطرق العامة لإجراء دراسات تقييم التأثيرات البيئية وكيفية تقييم هذه الدراسات
- الإجراءات الموحدة لتراخيص مثل هذه المشاريع لما لها من أهمية في توحيد و تعزيز أوجه التعاون في مجال الاستزراع السمكي.
- مواصفات اختيار مواقع الاستزراع.
- بالإضافة إلى ممارسات الإدارة الأفضل في مثل هذه المشاريع.

ضيوفنا الكرام،،،

اسمحوا لي أن نتقدم بجزيل الشكر والتقدير لجميع الدول المشاركة ومجموعة العمل وخبراء وممثلي منظمة الأغذية والزراعة على تلبية الدعوة و على جهودهم المخلصة التي ساهمت في عقد هذا الاجتماع. كما أتقدم بالشكر لكل من ساهم من أجل انعقاد هذا الاجتماع وعلى وجهة الخصوص اللجنة المشرفة على التنظيم من العاملين بوزارة الثروة السمكية و وزارة القوي العاملة كما نتقدم لكم جميعاً بجزيل الشكر لتلبية الدعوة ولحضوركم الكريم.

والسلام عليكم ورحمة الله وبركاته،،،

Summary of workshop suggestions and recommendations

CAGE AQUACULTURE IN THE RECOFI AREA

The WGA *asked for* intensification of research to refine hatchery technologies to ensure mass production of species for cage aquaculture (paragraph 13).

The WGA *suggested* that proper site identification and aquaculture zoning could help reduce conflicts of interest among different and potential users of the coastal and marine environment (paragraph 15).

The WGA *agreed* that the development of common environmental protocols is needed for countries sharing the same water body (paragraph 16).

The WGA *recommended* that relevant environmental data should be collected, compiled and provided in an accessible form along with information on site selection criteria and area availability for cage fish farming (paragraph 17).

The WGA *agreed* that the encouragement of coastal zoning through the use of appropriate spatial planning tools would allow the identification and allocation of specific geographical areas to aquaculture operations. This would simplify the process of farm site selection, environmental impact assessment and licensing procedures (paragraph 18).

It was *proposed* that the WGA should review regional competence in the use of spatial planning tools and organize an inception workshop that would synthesize the knowledge acquired in the region and to recommend a road map on how to move forward (paragraph 18).

CAGE AQUACULTURE – ENVIRONMENTAL IMPACT AND MONITORING

The WGA *recognized* the need for the region and individual Commission members to develop an ad hoc EIA format based on the local marine environment conditions to determine the level of detail and elements for the completion of a full EIA study (paragraph 21).

The WGA *agreed* that the preparation of an inventory in each country of relevant habitats, natural oceanographic and topographic conditions was needed to draw up a detailed protocol and specify where to carry out specific investigations (paragraph 22).

The WGA *emphasized* the concern of the impact of aquaculture on the fishing community (paragraph 23).

The WGA *encouraged* appropriate training for the techno-bureaucrats in dealing and interpreting the results of an environmental impact assessment study (paragraph 24).

The WGA *recognized* the importance of obtaining detailed information on how to monitor cage fish farms with regards both to their benthic and pelagic impacts and suggested the monitoring programmes from other cage culture farming countries could be used but adopted to local conditions. The WGA *emphasized* the importance of monitoring results against threshold impact limits (paragraph 27).

In order to develop and establish a standard and specific fish cage culture monitoring protocol in the region, the WGA *recommended* that the RECOFI countries be responsible for the adaptation of an existing monitoring cage farming programme and EQS by establishing contact with a research institute that holds expertise in cage farming impact and monitoring. The Secretariat was *invited* to investigate expert training on monitoring procedures in Norway or other countries with an adequate and functional fish cage aquaculture monitoring programme (paragraph 29).

The WGA *agreed* that adequate information should be provided to a potential investor, in order to convey a clear understanding of the licensing application and procedure (paragraph 35).

The WGA *agreed* that the legislation involved and process in aquaculture licensing should be transparent and provide ready information on e.g. processing time, payable fees, financial guarantee for bankruptcy, etc. (paragraph 35).

The WGA *suggested* that the countries in the region should prepare an instruction guide on how to complete a licence application (paragraph 35).

The WGA *agreed* that potential aquaculture investors in the region should be informed on the necessary information to be collected prior to applying for a farm licence for a specific site (paragraph 36).

OTHER MATTERS

Algal blooms and cage aquaculture

The experts *recommended* that the WGA should organize a technical workshop on the impact of hazardous algae on aquaculture and cage culture. It was also *recommended* that the proposed workshop should be coordinated with the agenda of the Regional Organization for the Protection of the Marine Environment (ROPME) in view of the mandate of this regional organization (paragraphs 43 and 44).

Fish cage demonstration farm

The WGA *suggested* that the establishment of a commercial demonstration cage farm would greatly enhance the opportunity to gain and share the necessary experience and provide an opportunity for the authorities to evaluate the suitability of their regulations and procedures. The demonstration cage farm would allow the observation and monitoring of environmental impacts, improve husbandry practice, demonstrate the need for enforcement and make indirect tests of the regulations (paragraphs 45 and 46).

The WGA *agreed* that the farm could serve as a training centre for fish farmers, consultants and representatives of the authorities that deal with the processing of licences, environmental impact assessment and monitoring procedures and their enforcement (paragraph 47).

The WGA *encourages* the information exchange between existing research facilities (including universities) and the development of joint research cooperation programmes within the region (paragraph 47).

RECOFI-WGA legal aquaculture project proposal

The experts *recognized* the importance in implementing the legal and aquaculture project prepared by the WGA and endorsed by the Commission. The WGA was *invited* to raise the issue at the next session of the Commission in May 2009 (paragraph 48).

CLOSING REMARKS AND ADOPTION OF THE REPORT

The workshop participants acknowledged that the cage culture industry is still in an infancy stage and agreed that the governments in the region will play an important role in the future development and promotion of this farming practice as well as aquaculture as a whole (paragraph 49).

The Chairperson of the WGA *invited* all WGA focal points to circulate and discuss the workshop report and recommendations with the relevant national authorities in order to ensure a fruitful discussion during the next RECOFI (paragraph 50).

Terms of reference

COUNTRY REVIEW ON MARINE CAGE FARMING

The RECOFI-WGA Focal Points will be responsible for the preparation of a national review on marine cage culture. The reviews from all RECOFI members will be used to compile a regional status of marine cage culture. The country reviews along with the regional summary will be used as background material at the “Regional technical workshop on sustainable marine cage aquaculture development”.

The reviews will pay special attention to existing, if any, national monitoring and regulatory procedures pertinent to marine cage farming. Regulations, laws or soft laws on licensing procedures, site selection and environmental impact assessment methodology adopted at the national level should be detailed and attached in appendix as an integral part of the country review.

The review will cover cage culture in marine and backishwater environments highlighting core issues related to this aquaculture practice. The review should highlight what has worked, what went wrong and what are the lessons learnt and give special attention to the existing national monitoring and regulatory framework. The review should be completed with relevant tables and figures, and contain at least one map of the country indicating the areas where cage culture is prevalent and to what extent. Photographs, if included, should illustrate key systems and techniques.

The review will be prepared along the following guiding structure (additional headings may be added, if appropriate):

- **EXECUTIVE SUMMARY**
- **BRIEF HISTORY AND ORIGINE OF MARINE CAGE AQUACULTURE IN THE COUNTRY**
- **THE CURRENT SITUATION**
 1. Description of national coastline (incl. profile, slope gradient, wind prevalence, currents)
 2. Marine fish species currently farmed (or candidates) in cages (endemic and exotic)
 3. Seed (wild or hatchery-produced) and feed supply (locally manufactured or imported)
 4. Type and size of cages used (locally built or imported)
 5. Number of existing farms and number of cages (or current applications from the private sector)
 6. Current production outputs per species
- **CURRENT PROBLEMS RELATED TO CAGE MARICULTURE DEVELOPMENT**
- **CURRENT INSTITUTIONAL REQUIREMENTS FOR ESTABLISHING AND OPERATING A CAGE FARM**
 1. Site selection
 2. Farm licensing procedures
 3. Environmental impact assesment (EIA) and monitoring
- **INSTITUTIONAL DEVELOPMENTAL POLICY**
 1. National plans and targets
 2. Production for domestic markets or exports
 3. Employment and gender issues
 4. Others
- **REFERENCES**
- **APPENDICES**
 1. National regulations/legislations/guidelines on *licensing procedure* (if any)
 2. National regulations/legislations/guidelines on *site selection criteria* (if any)
 3. National regulations/legislations/guidelines on *environmental impact assessment* (if any)

RECOFI country reports on marine cage aquaculture

edited by

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Lovatelli, A. (ed.). 2009. RECOFI country reports on marine cage aquaculture. In FAO/Regional Commission for Fisheries. Report of the Regional Technical Workshop on Sustainable Marine Cage Aquaculture Development. Muscat, Sultanate of Oman, 25–26 January 2009. *FAO Fisheries and Aquaculture Report*. No. 892. Rome, FAO. pp. 23–76.

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INTRODUCTORY NOTE

The RECOFI country reviews on marine cage aquaculture were prepared in occasion of the RECOFI Working Group on Aquaculture (WGA) “Regional technical workshop on sustainable marine cage aquaculture”, held in Muscat, Sultanate of Oman, from 25 to 26 January 2009. The authors of the reviews were requested to follow as closely as possible the template prepared and circulated by the RECOFI Secretariat that appears in Appendix E of the present report. Some of the reviews below are rather comprehensive while others only provide scant information some what indicating the different developmental level of the cage aquaculture industry in the various RECOFI countries.

RECOFI members have been encouraging cage aquaculture over the years however the current level of development varies considerably among the countries and in general cage aquaculture can only be considered an economic activity in its early stages of development. The major constraint identified in the establishment of fish cages, particularly along the north-western shores of the Gulf, has been the limited availability of suitable farming sites characterized by shallow waters, highly fluctuating salinity and temperature levels, and inadequate sea currents. Other limitations included price competition from wild-caught fish, inadequate farming technologies for the region and the limited availability of endemic candidate species of commercial importance suitable for cage aquaculture

The first two pages of this Appendix provide official capture fisheries and aquaculture production statistics from 1998–2007 for the eight RECOFI countries extracted from the FAO FishStatPlus database.

* In order to facilitate the reading, in tables and lists these countries are abbreviated as: Iran IR, KSA and UAE, respectively.

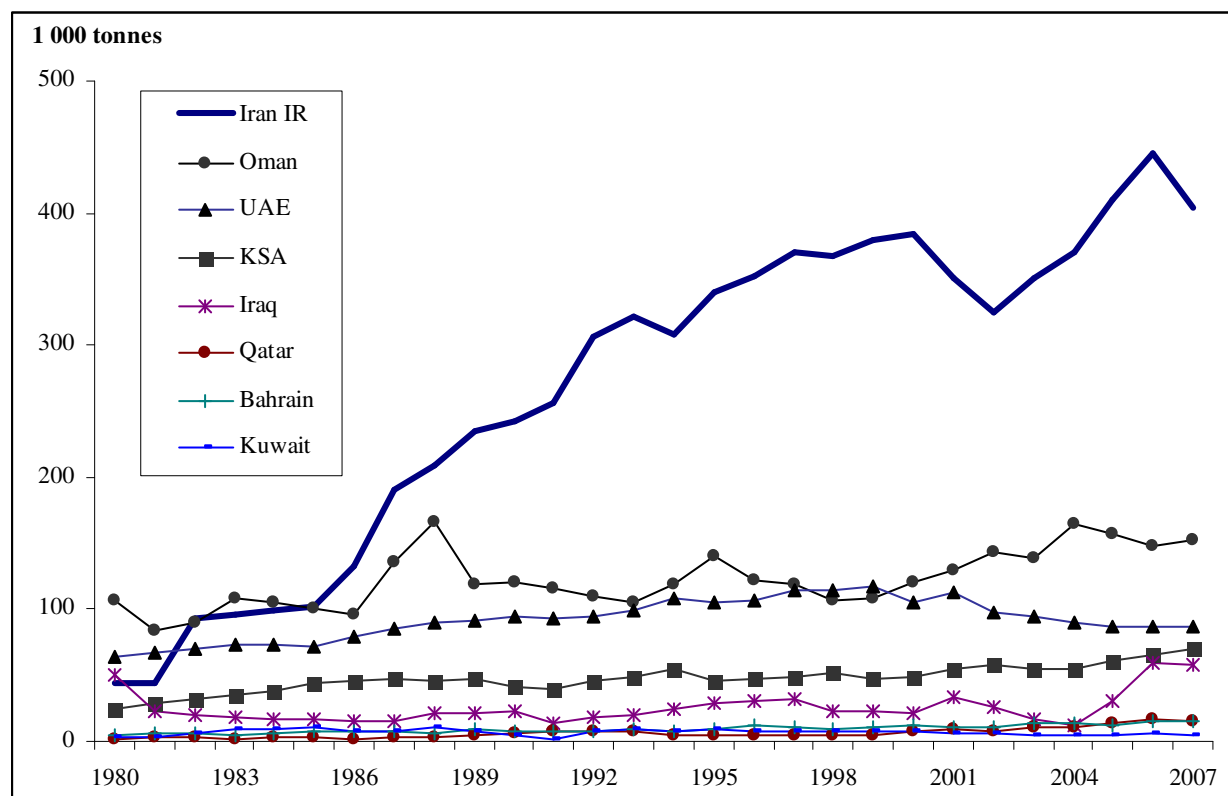
Capture fisheries production (tonnes)

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Bahrain	9 849	10 620	11 718	11 230	11 204	13 638	14 334	11 854	15 594	15 012
Iran IR	367 212	380 200	383 990	351 140	324 853	350 122	369 990	410 558	445 852	403 635
Iraq	22 574	22 423	20 767	33 300	26 000	17 200	12 936	29 929	59 259	57 779
Kuwait	7 798	7 398	6 977	5 846	5 360	4 059	4 833	4 895	5 635	4 373
Oman	106 171	108 809	120 421	129 907	142 670	138 481	165 082	157 326	147 669	151 744
Qatar	5 279	4 397	7 140	8 864	7 155	11 295	11 134	13 935	16 376	15 190
KSA	51 291	46 700	49 080	55 331	57 211	55 440	55 418	60 407	65 471	70 000
UAE	114 739	117 607	105 456	112 561	97 574	95 150	90 000	86 735	87 000	87 000
TOTAL	684 913	698 154	705 549	708 179	672 027	685 385	723 727	775 639	842 856	804 733

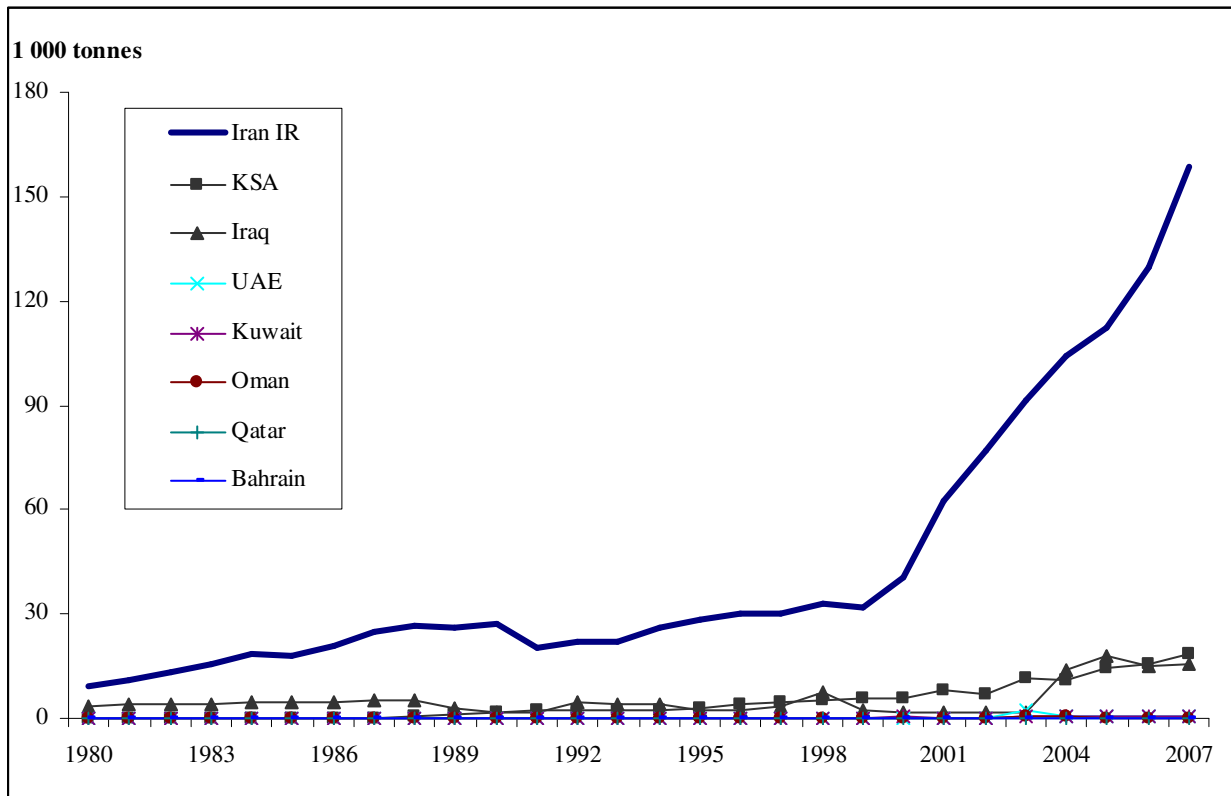
Aquaculture production (tonnes)

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Bahrain	1	3	12	0	3	4	8	3	2	1
Iran IR	33 237	31 800	40 550	62 550	76 817	91 714	104 330	112 001	129 708	158 789
Iraq	7 500	2 183	1 745	2 000	2 000	2 000	13 947	17 941	14 867	15 810
Kuwait	220	264	376	195	195	366	375	327	568	348
Oman	13	0	0	0	0	352	503	173	89	90
Qatar	0	0	0	1	0	0	0	11	36	36
KSA	5 101	5 620	6 004	8 218	6 744	11 824	11 172	14 375	15 586	18 410
UAE	0	0	0	0	0	2 300	570	570	570	570
TOTAL	46 072	39 870	48 687	72 964	85 759	108 560	130 905	145 401	161 426	194 054

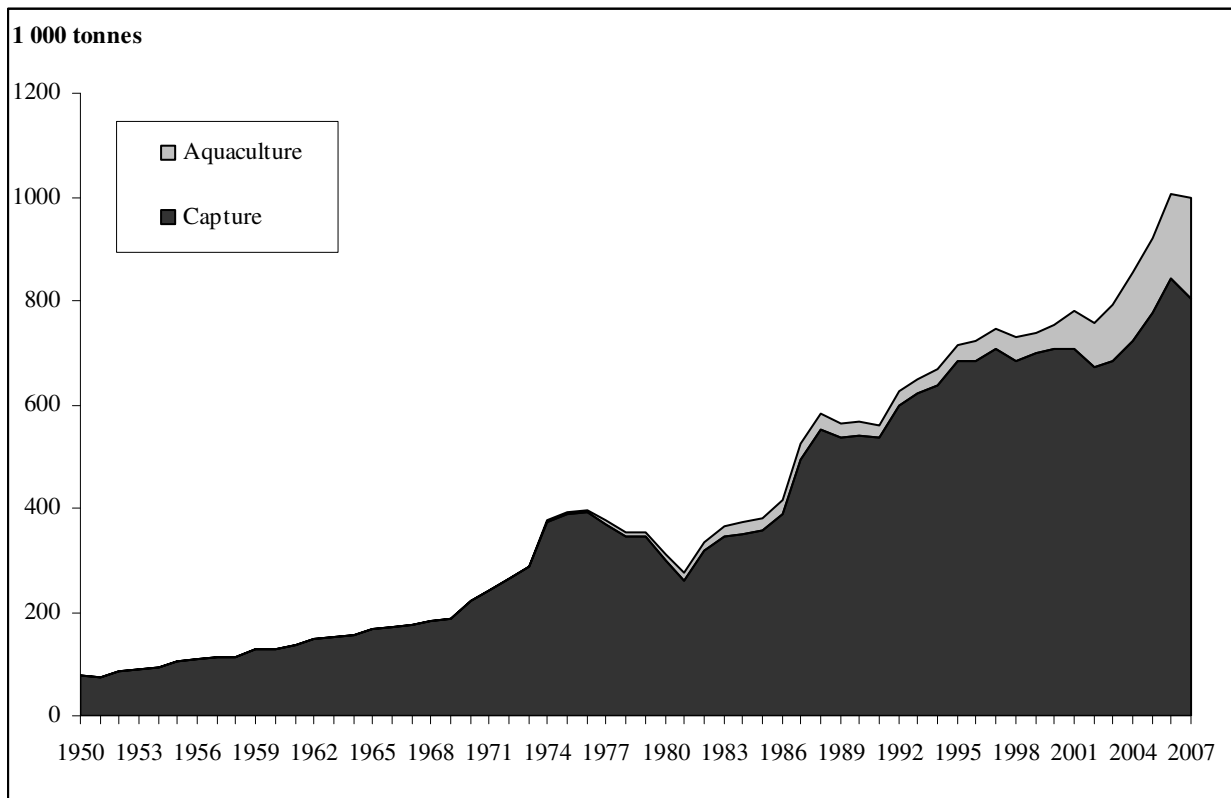
Capture fisheries production



Aquaculture production



Total production of RECOFI member countries



**Islamic Republic of Iran:
A review on marine cage aquaculture**

by

Mehdi Shakouri
Iran Fisheries Organization

BRIEF HISTORY OF MARINE CAGE AQUACULTURE

The Islamic Republic of Iran has some 50 years experience in aquaculture, mainly in pond culture of freshwater fishes including major Chinese carps and trout. The first cage farms were established 40 years ago in a reservoir of Karoon River in Khozestan province, southwest of the Islamic Republic of Iran. The cages were made of metal and some imported. In the 1980s use of hand made cages using traditional material expanded in inland water bodies for trout rearing. The current expansion of freshwater cage farming is limited mainly due to unsolved issues raised by the of water supply authority. Annual production in cage is limited to some 350 tonnes from 200 units.

Marine cage culture has a short history in the Islamic Republic of Iran. Early research activities on marine cage culture date back to the early 1990s when the Iranian Research Institute (IFRO) established some small experimental cages for the rearing of wild caught fish juveniles. In 2001 a contract was signed between the Iran Fisheries Organization (IFO) and a Norwegian company (Refa) to conduct a general survey of the coastal areas of the country. This survey gave IFO a general and reliable overview for the



Figure 1

development of marine fish cage farming. This study also indicated possible cage farming sites along the entire coast. Following the survey, IFO selected a cage site in the Persian Gulf near by Qeshm Island and established a pilot cage farm (see Figure 1). The farm was established in 2005 with the assistance of Scottish and Nordic companies. Local marine fish species like the yellowfin seabream and the Sobaity bream were farmed experimentally to achieve local standards for marine fish farming. A second pilot farm will be established in Busher province in 2009.

In early 2002, IFO invited private companies to investment in marine cage farming. As local hatcheries are not in a position to supply reliable amounts of fish juvenile, private companies that have been interested in investing in mariculture operations have yet to establish their farms.

THE IRANIAN COASTLINE

Caspian Sea – The Caspian is a closed sea, with a surface area of 244 000 km², and a maximum depth of 980 m in the south. It is enclosed by Azerbaijan, the Russian Federation, Kazakhstan, Turkmenistan and the Islamic Republic of Iran. Over 120 rivers flow into the Caspian Sea, with 75 percent of its waters derived from the Volga River in the north. The salinity of the Caspian Sea is constant at approximately 13 ppt, while the temperature in the surface layers fluctuates widely with the seasons. Most temperature data received for the southern Caspian indicate temperature extremes between 9 and 28 °C at the surface. In the vicinity of rivers and cold wind spells the temperature in the top surface

layer can drop to 6–7 °C. The seasonal thermocline is found between 15–40 m depth. Below the thermocline the temperature remains below 20 °C and can reach values of 6–7 °C.

The Iranian coastline extends for 990 km along the SW–S–SE section of the Caspian Sea, and its territorial waters cover the deepest southern sector (Figure 2). The coastline is linear and



open, without any bays or promontories to provide shelter to fish rearing cages. It is characterized by gently sloping sandy sediments, which progress to mud with increasing seawater depth and distance from the shore.

The East sector of the coast (from the border with Turkmenistan up to Kenar Darya area) is very shallow. The West coast, from the border with Azerbaijan up to Kopur Chal is also a shallow region. The central southern region has a deeper near-coast profile, with bottom slope of 0.3–1.5 percent. A number of large ports/harbours exist at the major towns, but there is a lack of other small ports/jetties along the coastline. Thus outside the principal ports it is possible to utilize only small craft (principally owned by fishermen cooperatives) which land directly onto the beach.

Tidal currents are negligible, with maximum velocity of 10–15 cm/sec. The current pattern is dominated by the influx from the Volga River and by wind forces; thus strong currents would normally be expected only during severe storms. Verbal communications have been received stating periodic occurrence of strong currents of some 2–3 knots (although one fishery officer stated even 6 knots) which damage fishermen's nets. These currents seem to be strongest at depths less than 20 m.

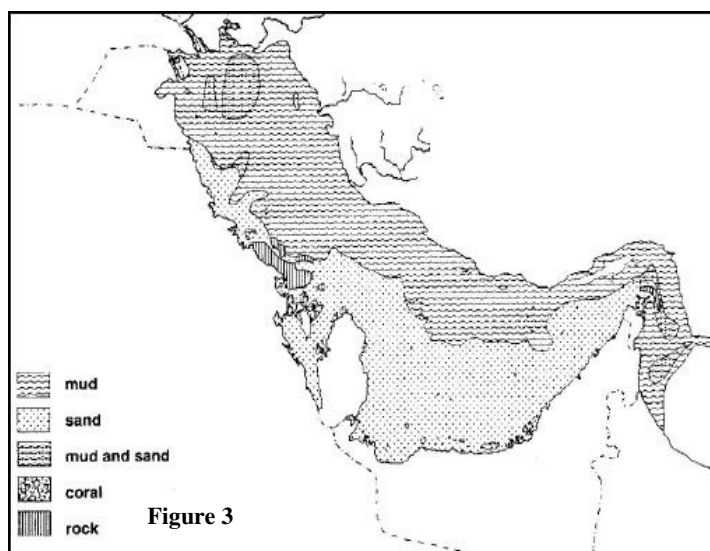
The shoreline is predominantly sand, with very scarce rocky outcrops. Progressing towards deeper water an increasing component of mud and clay is present, with quite uniform bottom substrates throughout the region. As an average value for the surveyed sites, the sediments can be characterized as (i) sand up to a depth of 8–12 m; (ii) sand-mud from 10–20 m; and (iii) mud-clay above 20 m.

Persian Gulf and Oman Sea – The marine basin to which the Persian Gulf belongs is bounded by the latitudes of 24° and 30° N and the longitudes of 48° and 56°E. It is a semi-closed water body which length varies from 800 to 1 300 kilometres and a maximum width of 640 kilometres. It is separated from the Gulf of Oman by the Strait of Hormuz which stretches 56 kilometres at its narrowest point. Its depth averages 35 m and most of the basin is less than 60 m deep. The depth in the Strait of Hormuz is 91 m and in the north-western part, near the Arvand estuary is 25 m. The Sea of Oman, with an estimated area of 94 000 km², length of 610 kilometres, and a depth reaching 3 200 m, connects the Persian Gulf to the Indian Ocean through the Arabian Sea. A series of rivers in the north influence sedimentation, salinity and current flow (Hendijan, Heleh and Mond rivers flow in from the Islamic Republic of Iran).

The bottom topography is mostly flat and featureless, dominated by soft sediments (mud and sand) (Figure 3). The area is a subtropical zone where air temperatures reach around 0°C in winter and 50°C and above in summer. Water temperatures reflect these harsh conditions and fluctuate in near shore waters between 10 and 40 °C while offshore surface water temperature fluctuations are moderated and between 18 and 33 °C. Many aquatic organisms in the region live at the limits of their physiological tolerance and must be able to survive these wide thermal fluctuations.

The arid climate influences water salinity, which in turn influences water density, currents, water mixing and other environmental parameters. The average salinity is around 37 ppt, but due to high evaporation rates in May the salinity may reach between 40–50 ppt in shallow areas.

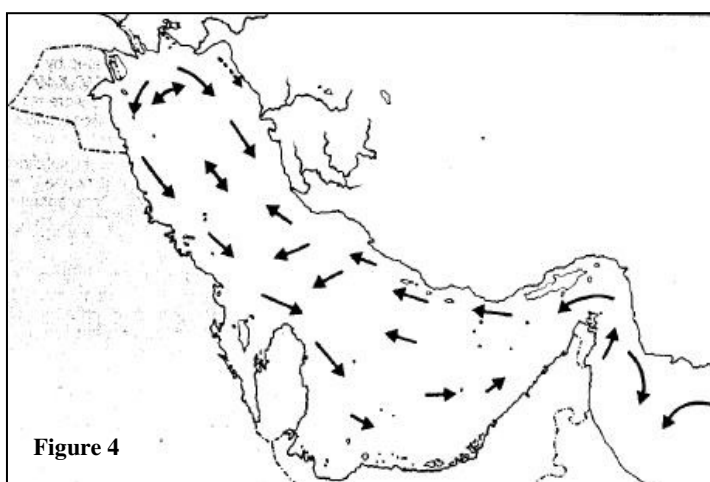
The dominant current is a counter clockwise movement with lower saline (less dense) water entering at the Straits of Hormuz at the surface and more saline (dense) water leaving the basin at the bottom. Thus, less saline (36,5–37 ppt) water entering the basin flows northward along the Iranian coast reaching 38 ppt in the North due to evaporation. As it flows southwards along the western side, the more saline water sinks, evaporation increases, and the denser water then flows towards the Straits of Hormuz along the bottom existing with a salinity of 40 ppt (see Figure 4).



Moving south-east from Bandar Abbas, the Iranian coastline becomes progressively more exposed to long fetch of open sea. The Strait of Hormuz represents a transition zone between the closed waters of the Persian Gulf and the open ocean waters of the Sea of Oman.

SITE SELECTION CRITERIA

The proposed criteria for site selection are: (i) present and future sources of pollutants and interference (from local fishing activities, shipping and transportation routes, tourism and recreation, industries and military activities); (ii) presence of natural sanctuaries, reserves and spawning grounds of important and/or endangered species; (iii) physical and chemical quality of water (e.g. temperature, salinity, currents, waves and turbulence); (iv) presence of other infrastructures.



CAGE FARMING FISH CANDIDATES

The current candidates for cage farming are listed below. Endemic species have higher priority as farming of alien fish species requires a long process before they are introduced for farming.

In southern waters - Local fish: Orange-spotted grouper or Hamoor (*Epinephelus coioides*); Yellow seabream (*Acanthopagrus latus*); Sobaity seabream (*Sparidentex hasta*); Silver pomfret (*Pampus argenteus*); dolphinfish (*Coryphaena hippurus*); milkfish (*Chanos chanos*); and Cobia (*Rachycentron canadum*). **Alien fish:** gilthead seabream (*Sparus aurata*); and the European seabass (*Dicentrarchus labrax*).

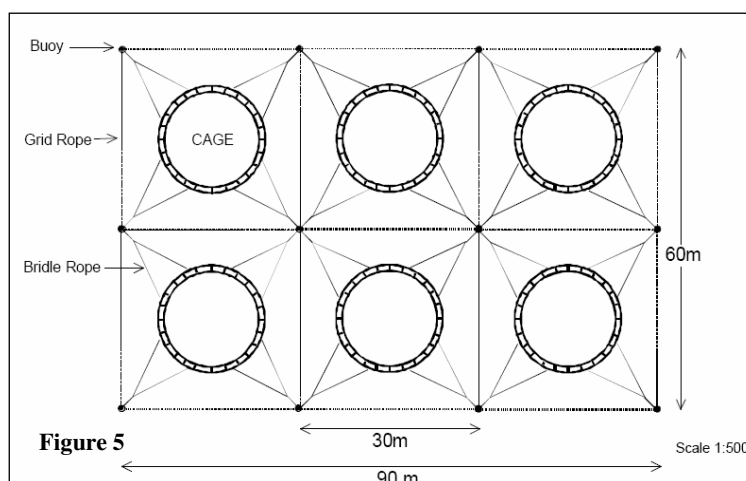
In northern water – Caspian trout (*Salmo trutta caspius*); Kutum (*Rutilus frisii kutum*); and five species of sturgeon (*Acipenser* spp.).

In IFOs' pilot farm Sobaity seabream and the gilthead seabream are currently farmed experimentally. The local species showed a rapid growth compared to the alien one with seed material provided from a local hatchery and imported from Bahrain, respectively. A priority for the Government is to ensure the

supply of juveniles from local hatcheries, while facilities in neighbouring countries such as Bahrain and Kuwait would be an alternative source of seed. The local feed companies have the capability to produce specific aquafeeds, but need to compete with foreign companies for price and quality.

TYPE & SIZE OF CAGES USED

The cages used in the pilot farm were imported in 2004. They consisted of six circular, 50 m polyethylene floating cage. The farm layout and mooring system used are illustrated in Figures 5 and 6. The annual production capacity of the farm is 180 tonnes of fish (30 tonnes/cage). At the present the pilot farm is the only cage farm in the Iranian water of the Persian Gulf. Private companies are still searching a reliable source of fish juvenile inside the country and in neighbouring states.



DEVELOPMENT PLAN

According to the IFOs' survey report, the Islamic Republic of Iran has the production capacity of 155 000 tonnes of marine farmed fish along the southern coastal waters while almost double this off the northern coastline (see Table 1).

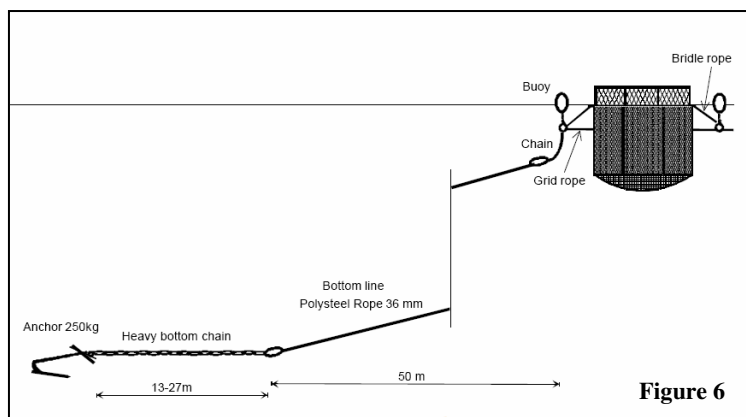


Table 1. Estimated capacity for cage farming in the Iranian coasts of the Persian Gulf

Site	Production capacity
Bandar-e-Mahshahr	2 000
Khark and Kharko Island	10 000
Kangan, Tombak, Akhtar and Taheri	20 000
Bandar-e-Javadol Aeme	10 000
Mogam, Chiroye, Gorze and Charak	30 000
Hendorabi Island	10 000
Kish Island	15 000
Faror Island	10 000
Qeshm Island	20 000
Larak Island	10 000
Hengam Island	8 000
Kuhestak	10 000
Total	155 000

The fourth national plan for development of marine cage culture indicates that the target production in 2009 should reach 4 500 tonnes. This objective is unlikely to be reached due to two major constraints i.e. the availability of a reliable source of seed material and the availability of better investment opportunities in other commercial fields.

The major constraints and threats for development of cage farming are:

- Lack of qualified technicians and experts in different and relevant areas;
- Shortage of seed material; and
- The difference between production cost and market price only allows for a narrow profit margin.

The major strengths and opportunities are:

- Availability of wild commercial finfish species;
- Presence of shrimp hatcheries with free production capacity;
- A large national market;
- Strong government support (low cost land; availability of favourable loans, etc.); and
- Presence of feed mill plants.

The Government welcomes and supports foreign investment in seed production and cage farming in both northern and southern waters.

FARM LICENSING

Farm licensing follows a certain process starting with the writing of an application to the IFO's provincial authorities. An environmental impact assessment (EIA) report is needed to issue a construction licence which needs to be approved by the Department of Environment Protection.

The licensing process is as below:

- Apply for cage farming by sending an application form to the provincial IFOs' office;
- Submit an overall business activity plan to the IFOs' office, if required;
- IFO issues a Principle Licence;
- Submit a feasibility study to the IFOs' office, including construction plans;
- IFO issues a Construction Licence (only after other relevant organizations such as the Department of Environment, the Maritime and Port Organization, and the Veterinary Services have approved the plan. A copy of the EIA report needs to be submitted to the Department of Environment); and
- IFO issues an Operation Licence when the farm is completed and farming activities can commence.

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Refa Holding AS. 2002. Main Frame Study for Sea Cage Culture Development in Iran. Executive Report to the Iran Fisheries Organization.

**Kingdom of Bahrain:
National review on marine cage aquaculture**

by

Abdulredha J. Shams
Director of Marine Resources
General Directorate for the Protection of Marine Resources

EXECUTIVE SUMMARY

The Kingdom of Bahrain has no commercial mariculture activities. Main production outputs consists of marine fish juveniles for export and local stock enhancement programmes. The coastal waters are open with no protected bays or sheltered areas and are generally shallow, with only small deep areas in the form of depressions in the sea floor. Salinities are high, tidal currents and wind velocities are medium to high. There is a potential for shallow net cage farming in selected areas, but measures for protection of cages against natural elements need to be considered. The presence of a successful and thriving fish juvenile production industry is a positive asset that will no doubt encourage future cage farming projects in the country. There are few but insufficient laws and regulations for mariculture activities including cage farming. There is a need to develop these regulations and also establish guidelines for environmental impact assessments and environmental monitoring programmes for mariculture projects.

GENERAL INFORMATION

Bahrain consists of an archipelago of islands in the shallow waters of the central Arabian Gulf (Figure 1). This archipelago comprises 36 islands covering a total area of 706 km². The largest island is the island of Bahrain, covering an area of about 590 km², where the capital Manama is located. The island is linked by causeways to neighbouring lands such as Muharraq, Sitra, Umm Na'san and Nabih Salih. The main island is also linked by a causeway to the Kingdom of Saudi Arabia. The other large islands of the Bahrain archipelago include Hawar, situated 25 kilometres to the south-east of the main island and covering an area of about 52 km². In order to meet the needs of the population, a further area of about 33 km² was reclaimed from the sea through landfill between 1976 and 1996. The reclamation is still continuing to coop with the development of tourism and industrial projects. In 2002, 13.3 percent of the existing land was used for housing purposes, 5.9 percent for agriculture, 9.3 percent for industry and commerce, 5.9 percent for the cultural heritage and tourism, and 16.5 percent by the gas and petroleum sector.



There is good potential for aquaculture development in Bahrain. Therefore, the Directorate of Marine Resources, General Directorate for the Protection of Marine resources, Public Commission for the Protection of Marine Resources, Environment and Wildlife has future plans to add new research and culture facilities to the National Mariculture Centre in order to cope with the expected expansion in this important sector. The rules and regulations that will control this sector are being planned. The Master plan for mariculture development in the Kingdom of Bahrain, formulated by the Directorate of Marine Resources, is continuously revised and discussed among different governmental authorities who have relation with the aquaculture affairs.

HISTORY OF MARINE CAGE AQUACULTURE

There is no marine cage farming activity in the Kingdom of Bahrain. In 1999, a trial was made using six 40 m perimeter circular floating cages. These cages were anchored at the marine terminal of the Bahrain Aluminium Factory (ALBA). This site was chosen mainly due to ease of access and anchoring of cages and security. The depth was just 9 m, so cage depth was limited to five metres. The cages were operated for two years; many problems were encountered, including profuse net fouling by amphipods and barracuda attacks. The problems were solved, but the site proved not to be suitable. Furthermore, due to expansion works by the factory, the whole operation had to be halted. This was the first and only cage farming operation in the country. Nevertheless, good experience was acquired even though the period of operation was short.

The coastal waters around the Kingdom of Bahrain are generally shallow, with natural depth not exceeding 26 m. But these depths are only limited to small size depressions on the sea bottom. Constant depth over a large area is rare in near coastal waters; the majority of the coastal area is below 10 m deep, not considering dredged navigation channels. There are few larger size deep depressions of 12–16 m that may be suitable sites for shallow cage farming. Except for scattered dead or semi-dead reef areas, most of the coastal areas have sandy bottom with few small rocky outcrops. In some areas the intertidal zone stretches to several kilometres, this and the fact that near coastal areas are mainly shallow, leave very little locations near to the land that are suitable for floating cages. Such conditions may encourage consideration of fixed cage farming.

The coasts of the Kingdom of Bahrain are mainly straight with no sheltered bays. The western coast has high sea water salinity, making it less desirable for farming. Therefore, the Eastern coast is looked at when cage farming is considered. Salinity is 42–45 ppt in most areas; in the south-western coast it may reach 60 ppt. The temperatures range from 16–35 °C. Temperature fluctuations often occur in the winter, especially during days of strong cold winds, causing a drop of a few degrees in a single day.

The tidal currents are rather strong, ranging from 0.1 to 3.5 knots; stronger currents are observed in deeper areas. Wave height in open waters can reach 2 m, especially in the northern areas, mainly due to strong prevailing north and north-western winds with a maximum velocity reaching 34 miles/hour.

There is no cage farming activity in the country, but there are marine species being produced and exported as seed for cage farming in other countries, these species are likely candidates for cage farming in the country and include Sobaity bream (*Sparidentex hasta*), gilthead seabream (*Sparus aurata*), orange-spotted grouper (*Epinephelus coioides*), rabbit fish (*Siganus canaliculatus*), mangrove snapper (*Lutjanus argentimaculatus*). Other species considered are Cobia (*Rachycentron canadum*) and the red seabream (*Pagrus major*).

Fish juveniles are currently being produced at a commercial scale in the country. The National Mariculture Centre, Directorate of Marine Resources, is a leader in the region in production of juveniles of a number of fish species. There are no fish feed mills in the country, hence all fish feed used is imported.

The following table shows the species and numbers of seed produced at the National Mariculture Centre in recent years.

Year	Species	Fry produced (>1g)
2000	Sobaity bream (<i>Sparidentex hasta</i>)	525 000
2001	Sobaity bream	395 000
2002	Sobaity bream	540 000
	Rabbit fish (<i>Siganus canaliculatus</i>)	20 000
2003	Sobaity bream	240 000
	Rabbit fish	30 000
	Mangrove snapper (<i>Lutjanus argentimaculatus</i>)	4 000
2004	Sobaity bream	370 000
	Rabbit fish	97 800
	Mangrove Snapper	–
2005	Sobaity bream	272 250
	Rabbit fish	–
	Gilthead seabream (<i>Sparus aurata</i>)	1 936 506
2006	Sobaity bream	635 000
	Grouper (<i>Epinephelus coioides</i>)	87 950
	Gilthead seabream	2 914 000
2007	Sobaity bream	347 652
	Gilthead seabream	2 675 739

The Directorate of Marine Resources, General Directorate for the Protection of Marine Resources, is not the direct body that regulates and controls quality and safety of aquatic products. It only issues export licences for marine products and issues permits for any fish catch and processing business. There are no other specific laws or regulations for fish farming; there are also no guidelines for environment impact assessment or for any environmental monitoring programmes for mariculture. The Royal Decree on Exploitation and Utilization of the Marine Resources, issued in 2002, has a few provisions for controlling aquaculture activities of cultured organisms in different aspects such as licensing and its requirements and quality issues. According to the law, a company is not permitted to start any aquaculture project or harvest wild seed without permission from the authorized government body (General Directorate for Protection of Marine Resources).

Major constraints that could affect cage mariculture in the Kingdom of Bahrain include shortage of suitable areas with suitable depth, need for protection against tides, winds and currents, shortage of coastal land to establish supporting facilities for cage farms. On the other hand, incentives for establishing such industry include availability of long-term low interest loans, availability of seed and good technical backup.

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**Kingdom of Saudi Arabia:
A review on marine cage aquaculture**

by

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Ministry of Agriculture

EXECUTIVE SUMMARY

The Kingdom of Saudi Arabia occupies approximately 80 percent of the Arabian Peninsula surface area. The Kingdom has a good potential for fish farming considering the advantages offered by favourable climatic conditions, availability of land and water, and an expanding national market. By virtue of its position between the Arabian Gulf and the Red Sea, the country has a rich diversity of finfish and shellfish species. Some of the endemic species have been identified as potential and suitable aquaculture candidates. The combined coastline of the Red Sea and the Arabian Gulf extends approximately to 2 400 kilometres. The Ministry of Agriculture has identified marine as well as freshwater aquaculture as an important economic sector for the provision of fish and fish products to the national and export markets and provides support to its further development.

In the past few years special attention has been given by the Government to boost commercial aquaculture production in the Kingdom and has encouraged both national and foreign investments. To support such investments the Ministry of Agriculture provides a number of incentives including facilitations to obtain suitable land and sea areas, operational licences as well as providing advantageous financial loans. Furthermore, the Ministry has established a number of semi-commercial aquaculture projects to attract such investments.

The Department of Aquaculture is the responsible authority for issuing licences to establish and operate aquaculture projects. These are released only after an evaluation of the feasibility studies of submitted projects. To date aquaculture activities in the Kingdom have been mainly established as complimentary activities to agriculture projects or as ad hoc inland freshwater activities. Coastal aquaculture projects are presently located along the coast of the Red Sea. In 1986 aquaculture contributed less than 1 percent of fish production in the Kingdom of Saudi Arabia. This value increased to 10 percent in 2000 and to 17.6 percent in 2003 with shrimp farming considered the most successful and expanding aquaculture activity.

There are several marine finfish species that have been identified as suitable for marine cage aquaculture activities. These include the rabbit fish (*Siganus* sp.), mullet (*Mugil* sp.), yellowfin seabream (*Acanthopagrus latus*), the Sabaki tilapia (*Oreochromis spilurus*), the exotic Asian seabass (*Lates calcarifer*), and a number of grouper (*Epinephelus* spp.) and snapper species (*Lutjanus* spp.). The Asian seabass is a recommended species particularly as the country has successfully introduced the hatchery technology for this species. At present only one company (Fisheries Tabuk Company) has established a cage culture operation on the northern reaches of the Red Sea (near Tabuk) farming the Mediterranean gilthead seabream (*Sparus aurata*). Marine cage culture is expected to become an important source of fish production in the future, however a stronger support should be provided to the private sector particularly with regards to the use of modern open sea cages and access to hatchery technologies.

CONSTRAINTS TO CAGE MARICULTURE DEVELOPMENT

The major constraint to a larger-scale development of marine finfish culture in the Kingdom of Saudi Arabia is the uncertain supply of fish fingerlings of commercially important species. Artificial

breeding of certain marine finfish such as the Asian seabass (*L. calcarifer*) and certain species of groupers (*Epinephelus* spp.) has been successful. However, mass fingerling production of these species is still at the experimental level.

Another constraint to cage aquaculture development is the limited knowledge of suitable cage farming areas, which in the case of the Arabia Gulf may be somewhat limited compared to the Red Sea due to the its low bathymetry. Furthermore, the public is also concerned of the impacts of aquaculture practices on the natural environment particularly in near shore waters. One strategy advocated by the authorities is the development and introduction of offshore cage culture technology.

INSTITUTIONAL REQUIREMENTS FOR ESTABLISHING AND OPERATING A CAGE FARM

Site selection

Amongst the most important consideration in starting an aquaculture project is proper site selection. A good site should comply with the technical requirements to enable proper management of the system. Good sites for cage culture include sheltered shores, bays, straits and lagoons. Adequate water exchange is necessary to ensure stability of the environment and culture conditions. However, it is necessary to avoid areas where there is a large influx of freshwater especially during the rainy season as this could result in sudden changes of salinity values which may cause fish mortalities. The following parameters should be taken into account during a cage culture site survey:

Sheltered area – It is important that sites for cage culture are sheltered particularly from strong winds and strong wave action. Sea areas with wave amplitude greater than 2 m should be avoided except in the case modern offshore floating cages are used. Strong winds and wave action will damage conventional cage structures as well as render maintenance and management work very difficult and dangerous. Ideal sites are those that have a good natural protection.

Current – Water currents play a major role in maintaining good water quality around cage fish farms. An adequate water exchange will ensure a high level of oxygen essential for intensive culture system, while poor water exchange may results in the accumulation of waste products beneath the cages. Excessively strong currents however will stress the farmed fish and force them to utilize excessive energy to maintain their position in the cage. Both the factors can significantly lower growth rates of the fish. A current with a speed of 20–50 cm/sec. is considered suitable for a cage culture project.

Depth – The water depth in a cage culture site should be large enough to ensure proper water circulation and flushing of the waste material. The importance of maintaining the cages off the bottom is also to avoid unnecessary contamination that may result in disease outbreaks among the cultured fish. For small fixed bottom cages it is recommended that at least 2 m separate the bottom of the cage and the sea floor. Sandy-clay bottoms are ideal for fixing such cages.

Dissolved oxygen – Adequate dissolved oxygen (DO) levels are essential for fish to live and grow satisfactorily. It is recommended to determine the surface and bottom DO to ensure that the levels do not fall below 4 ppm which may stress the fish. A DO level of 5 ppm or more is necessary for good growth.

Temperature – The temperature of Saudi Arabian waters do not fluctuate significantly throughout the year. It is generally between 27–32 °C which allows year round fish culture. Temperatures lower than the optimum value will slow fish growth while extreme values may induce severe mortalities.

Salinity – In the coastal areas of the Kingdom of Saudi Arabia salinity values may reach 35–44 ppt.

Pollution – Pollution in coastal areas usually results from land discharges such as sewage, industrial

wastes, insecticides runoff and the mining discharges. Pollutants which have toxic elements may not be lethal immediately but may accumulate to the lethal point or cause disease outbreaks as a result of stress. A suitable farm site should be far from any such pollution sources. Urban or areas with heavy industrialization should be avoided.

Farm licensing

According to the standards and regulations adopted by the Department of Aquaculture.

Environmental impact assessment and monitoring programme

Environmental impacts as a result of farming activities in the Kingdom of Saudi Arabia is a matter of great concern and specific environmental impact assessment study is required for all coastal projects and is required before a farm licence can be issued. Animal rearing including intensive fish farming has an impact on the natural environment, like all human activity. The major impacts are associated with feeding and nutritional wastes which may affect water quality as a whole and the benthic community beneath the cages as a result of organic matter build-up. These adverse effects may be somewhat reduced through improved feeding management and integrated aquaculture. Environmental monitoring is carried out by the competent authorities under the direct supervision of the Department of Aquaculture through regular field visits and sampling programmes.

INSTITUTIONAL SETUP

The Department of Aquaculture (DoA) is directly linked to the Deputy Minister for Fisheries Affairs and its main task is to control, regulate and supervise all coastal and inland aquaculture operations as well as to support research projects focussed on the identification of the most suitable fish and shrimp species for farming purposes. The DoA also extends support with regards to the identification suitable sites where aquaculture operations can be established. It is also entrusted with preparing and revising short- and long-term aquaculture developmental plans. The Department also conducts market analysis for aquaculture products which are made available to the private sector. The DoA operates five functional units: 1) Freshwater Research Unit; 2) Marine Water Research Unit; 3) Aquaculture Development Unit; 4) Production Follow-up Unit; and the 5) Aquaculture Services Unit.

Governing regulations

The law regulating fishing, investment and protection of living aquatic fisheries resources in the Kingdom of Saudi Arabia was issued as the Royal Decree No. M/9 in 27/3/1408 entrusting the Ministry of Agriculture with the responsibility of supervising and developing this economic sector. The Ministry supervises this industry through the Deputy Ministry of Fisheries Affairs by establishing general policies, planning and designing short- and long-term developmental programmes. The Deputy Ministry issues resolutions and regulating by-laws, and supervises three separate departments: 1) the Department of Aquaculture, 2) the Department of Fisheries and 3) the Department of Aquatic Environment. It also supervises the activities of a number of research centres and the regional fishery offices located on both coasts.

Research, education and training

Applied research, education and training in the field of aquaculture are carried out by a number of fisheries research centres, selected universities and at the King Abdul-Aziz City for Science and Technology (KAST). This latter institution plays a major role in developing freshwater aquaculture through its field stations located in Derap and El-Kasim. All these centres provide technical and extension services to all national aquaculture projects and are: 1) the Fish Farming Centre in Jeddah; 2) the Eastern Province Fisheries Research Centre; 3) The Red Sea Fisheries Research Centre; and 4) the Fish Health and Safety Laboratories in Jeddah and Dammam (currently being established).

Fish Farming Centre

The Fish Farming Centre in Jeddah was established in 1982 under an agreement signed between the Ministry of Agriculture and the Food and Agriculture Organization of the United Nations (FAO). The Centre main focus is on applied research aimed at identifying marine fish and shrimp candidate species suitable for local aquaculture operations, transfer of farming know-how and training. The Centre is located on the Red Sea coast approximately 60 kilometres north of Jeddah. Through its Marine Fish Programme the Centre has succeeded in domesticating several species of commercially important fish species and maintains healthy broodstock of several grouper species, *Siganus*, mullet, seabream and seabass. The current research focuses on mass fish larval/fingerling production and reduction of hatchery operation costs. Under the Shrimp Aquaculture Programme extensive research has been conducted on the Indian white shrimp (*Penaeus indicus*) and the giant shrimp (*Penaeus monodon*). Through its research and extension service the Fish Farming Centre is credited for successfully introducing and promoting shrimp aquaculture in the country. Work has also been carried out on tilapia a species highly tolerant to adverse environmental conditions, extremes levels of temperature and salinity. The farming of this species has expanded throughout the country. The Centre has also succeeded culturing the Sabaki tilapia (*Oreochromis spilurus*) in full strength seawater. Other research programmes focus on live feed organisms, feed formulation and fish diseases.

**State of Kuwait:
National review on marine cage aquaculture**

by

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EXECUTIVE SUMMARY

Fish culture using marine cages has been carried out in the State of Kuwait since 1992. The Government recognizes the importance of this aquaculture sub-sector as an alternative source of fish food particularly as fish from traditional capture fisheries have not been able to cope with the increasing demand for fish in Kuwait. Despite the fact that the prevailing arid climate with high evaporation rate (especially in the summer months) and the extreme temperature fluctuations are major hurdles, marine fish cage culture being promoted. Fish culture in floating cages is presently being carried out by a Kuwaiti-based shareholding company registered as “Bubiyah Fishing Company”. Gilthead seabream (*Sparus aurata*), the European seabass (*Dicentrarchus labrax*) and the endemic Sobaity seabream (*Sparidentex hasta*) are the major species candidates. In addition to these, other local commercially important fish species are being farmed experimentally in cages and these include the yellowfin seabream (*Acanthopagrus latus*), the thinlip grey mullet (*Mugil cephalus*) and the orange-spotted grouper (*Epinephelus coioides*). Though there are 73 cages with a total culture volume of about 116 000 m³, the actual number of cages currently being used is only a fraction. The reason for this may be attributed to the unavailability of fish fingerlings, unfavourable market trends and unsuitable environmental conditions.

The existing cages are located at Dawhah in the western part of Kuwait Bay. Fingerlings of the gilthead seabream, the European seabass and thinlip grey mullet are mainly imported from Greece, France and Egypt. A newly established company called “Gulf International Aquaculture Company” (GIAC) is also producing some fingerlings using part of the hatchery unit belonging to the Kuwait Institute for Scientific Research (KISR) on rental basis.

Fish production from cages has fluctuated, but annual average production has been around 127 tonnes between 2000 and 2007. Fish culture using marine cages receive all sorts of support from the Government represented by the Public Authority for Agriculture Affairs and Fish Resources (PAAFR). Subsidies are provided to the sector as it has been identified as a potential source of alternative seafood to supply the future demand for fish in the State of Kuwait.

BRIEF HISTORY ON CAGE CULTURE IN KUWAIT

Aquaculture development through experimental trials has been explored by KISR since 1983 and the sector gained momentum in 1990 with the concerted efforts of PAAFR. Marine finfish culture in cages started in 1992 by the “Bubiyah Fishing Company”. The company started fish production using 10 cages and then it expanded to 73 cages located at Dawhah in the western part of Kuwait Bay (Figures 1 and 2). At the beginning, 32 skilled persons were employed to look after the cage culture activities and an additional 25 people were engaged in marketing and export activities. The fish production from cages has been unstable and fell in recent years due to high competitive prizes of imported fishes and increasing maintenance cost. Despite these problems, fish cage culture activities are ongoing. Presently, a Kuwaiti general manager is looking after the management aspects of the fish farming operations. A technical manager and about 15 labours are engaged in the day-to-day maintenance work of the cages. The farmed fish that have reached the market size are sold locally through 10 company-owned outlets throughout Kuwait.



Figure 1

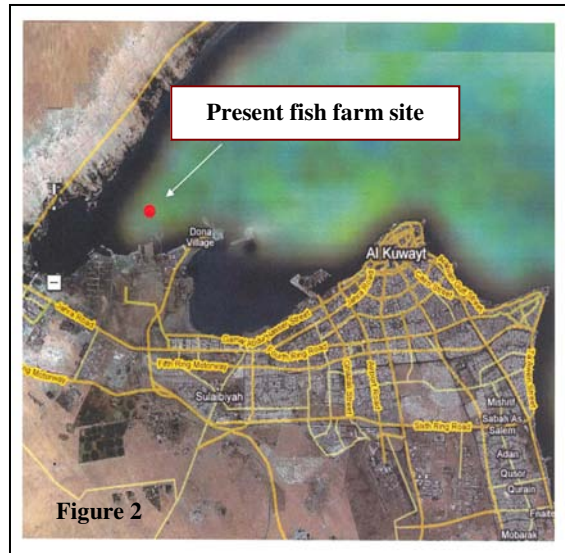


Figure 2

CURRENT SITUATION OF CAGE AQUACULTURE

Description of the national coastline

Kuwait is situated at the north-western end of the Arabian Gulf within the latitude of 28° N and 30° N and longitude of 47° E and 49° E. Kuwait has a total surface area of about 17 818 km² with a coast length of about 195 kilometres. Kuwait's marine territorial waters cover approximately 2 540 square nautical miles (8 700 km²) or just over half of the country's land area. The coastal line extends from the northern bank of Warba and Bubiyan Islands to the South Al-Khiran. The marine waters of Kuwait are characterized by a high finfish and shrimp species diversity.

Fish culture in floating cages commenced in Kuwait in 1992 and even though the production has been stagnating over recent years, this aquaculture sub-sector is receiving increase support from the Government in view of the limited space required and its potential in farming high value species. Highly demanded fish such as the gilthead seabream (*S. aurata*), the European seabass (*D. labrax*) and the Sobaity seabream (*S. hasta*) are major candidates as these species are highly preferred by the Kuwaitis. Further, these species are fast growing, have a phenomenal tolerance to crowded culture conditions and are resistant to extreme temperature fluctuations. Cage fish production is shown in Figure 3; values for 2006 and 2007 have been obtained from the Bubiyan Fishing Company and the remaining data are taken from the Statistic Bulletin of the Ministry of Planning, Kuwait.

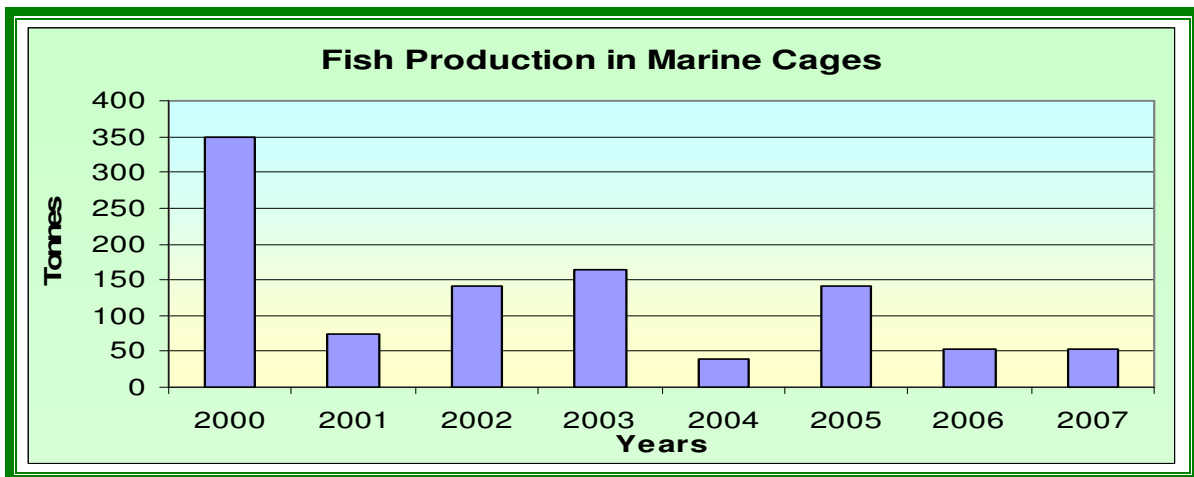


Figure 3

Supply of fish fingerlings

Fish fingerlings are entirely imported mainly from France, Greece and Egypt. Recently, Kuwait Institute for Scientific Research has constructed a modern hatchery unit. Part of this hatchery is used on rental basis by a private company (Gulf International Company for Aquaculture) which produces contained quantities of fingerlings of Sobaity seabream (*S. hasta*), yellowfin seabream (*A. latus*) and of the orange-spotted grouper (*E. coioides*) for export (see Figure 4).

Supply of fish feeds

Fish feeds are mostly imported from France and the Kingdom of Saudi Arabia through the ARASCO animal feed company which is the main fish feed supplier in Kuwait (protein and fat levels at 45 and 12 percent, respectively). More recently, fish feeds are manufactured on a small-scale by two Kuwaiti-based companies named "Sultan Feed Company" and "Kuwait Animal Feed Factory". With due consideration of the quality in term of fish growth rates, now Bubiyan Fishing Company is getting fish feed in limited scale from these companies.



Figure 4

Type and size of cages

The cages used for fish culture were previously the square type and now are all circular with a diameter of 20 meter and 8 meter depth. The outer rings of the cages are made of high density polyethylene (HDPE) pipes filled with buoyancy materials mainly thermocole and the nets are made of nylon material. These nets are periodically removed for cleaning and painting to avoid marine biofouling from organisms such as barnacles. A general view of the current cage site and replacement of a cage net are shown in Figures 5 and 6, respectively.



Figure 5



Figure 6

CURRENT CONSTRAINTS

Cage fish culture in Kuwait has faced severe problems particularly

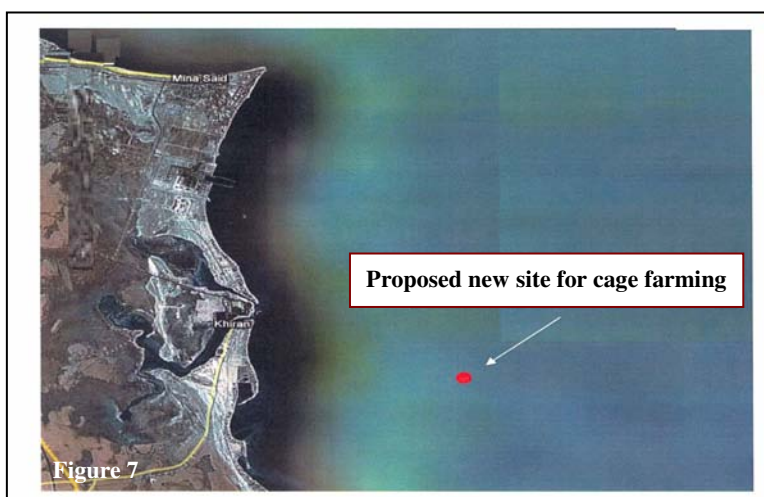
during the Iraq war in 2003 when all fishing activities were prohibited in Kuwait waters. The Bubiyan Fishing Company's staff was not allowed to visit the cage site during this time. Almost 50 percent of the cages had been washed away and destroyed discouraging the company to reinvest in new cages. Apart from this extraordinary event, the company has also to compete with local fishing companies that are importing fresh fish from neighbouring GGC (Gulf Cooperation Council) countries and placing them on the market at lower prices. This situation forces the company to keep their fish for longer periods, hence increasing production costs. Furthermore, factors such as the unavailability of fish fingerlings when required and high fish mortality due to a red tide occurrence in 1999–2000 has discouraged investments and development of fish cage culture activities in Kuwait.

CURRENT INSTITUTIONAL REQUIREMENT FOR ESTABLISHING CAGES

The present cage culture site is located in the Bay of Kuwait which is thought to be an important nursery ground for juvenile of many species of shrimps and finfish. The Bay of Kuwait has also rich *Sargassum* beds which are used as a preferred refuge by the most important commercial shrimp species in the area (*Penaeus semisulcatus*). Therefore, in order to protect the Bay with due consideration to such nursery habitats, commercial fishing is prohibited as well as in the three mile zone from the coast in accordance to the Ministerial Decree No. 11 of 1983. The Public Authority for Agriculture Affairs and Fish Resources is considering the relocation of the present and future cage culture activities from the Bay of Kuwait to a new site at Al-Kiran Marine Area as illustrated in Figure 7.

In this regard, the PAAFR has entrusted an Environmental Impact Assessment (EIA) study to the Kuwait Institute for Scientific Research on the transfer of the cages from the Bay of Kuwait to the new site. Based on the initial assessment of the EIA study, a new site at Al-Khiran has been identified as suitable for cage farming.

The site at Al-Khiran has the following characteristics (i) the site has a reasonable distant from the mainland and coastguards, (ii) the site has an adequate water depth and reasonable current speeds for natural flushing of the sea bed, and (iii) the site is far from navigational routes and from any petroleum submerged pipe lines. The EIA study is still ongoing and the final decision for the proposed site will be taken once the study is completed.



INSTITUTIONAL DEVELOPMENTAL POLICY

The Public Authority for Agriculture Affairs and Fish Resources (PAAFR) is the responsible authority for regulating cage fish culture activities in Kuwait. The overall fisheries activities in the State of Kuwait are administered under the law No. 46 of 1980. The PAAFR has enacted a specific resolution No. 293 in 2005 for aquaculture development in Kuwait. However, the resolution mainly aims at regulating land-based aquaculture activities. In order to encourage more investment in marine cage culture, PAAFR provides yearly subsidies, such as the one extended to the Bubiyan Fishing Company (KWD 25 000/yr or about USD 88 000). This subsidy is subject to reduction if the company's fish production drops below an agreed amount.

CONCLUSION

Aquaculture is considered as an alternative source of marine fish and has developmental potential in Kuwait. The country's natural fish stocks are under great biological stress and capture production figures have declined in recent years. Hence, aquaculture activities are gaining growing support from the Government. Cage aquaculture is expected to offer investment and employment opportunities in future. Recent developments including the establishment of a marine fish hatchery by the Gulf International Aquaculture Company and the identification of the newly proposed site at Al-Khiran are positive indications of the future development of marine aquaculture in Kuwait. The Bubiyan Fishing Company and other companies are likely to establish large cage operations once the new site is confirmed and accessible.

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**State of Qatar:
Marine cage aquaculture – A developmental opportunity?**

by

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EXECUTIVE SUMMARY

All types of aquaculture practices are new to the State of Qatar and the population mainly relies on wild fish catches as their primary source of fish. Commercial cage aquaculture production has not started and existing aquaculture activities have been conducted by researchers on small-scale freshwater facilities using tilapia.

At present there are no marine finfish species farmed, there is no availability of seed material (both wild-caught or hatchery produced) nor feed (either locally manufactured or imported). The Government of Qatar is nevertheless encouraging investments in offshore cage mariculture mainly as a result of limited land availability for land-based operation. However, the Fisheries Department has yet to propose formal institutional requirements for marine site selection, farm licensing, and environment impact assessment and monitoring programme.

With regards to underground freshwater water resources the Government encourages farmers to use the resource as best as possible for the production of agriculture products as well as fish (e.g. tilapia). Furthermore, the Agricultural Development Department has signed an agreement with the Industrial Bank by which long-term loans (25 years at 1.5 percent interest rate) are given to encourage farmer to establish fish farm. The aim of this policy is for the country to become self sufficient with regards to its domestic demand for fish and particularly freshwater fish.

At present, existing freshwater aquaculture operations employ mostly all-male Asian workers many of which come from India.

**Sultanate of Oman:
National review on marine cage aquaculture**

by

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EXECUTIVE SUMMARY

Oman has a long coast that faces three different seas with distinct environmental conditions. This, along with other structural and environmental advantages provides a high potential for the development of aquaculture activities. Aquaculture industry is still in its infancy stage but there is a strong commitment from the government to develop this sector in a competitive and sustainable manner that is in harmony with the social, economic, cultural and historic values of the country. Marine cage culture is an important sector of aquaculture in Oman. The first commercial aquaculture production in Oman came from this type of aquaculture. Numerous applications for marine cage culture projects by private entrepreneurs are currently under licensing evaluation. At present, there is only one commercial marine cage farm located in the Muscat Governorate which started production in 2003 (Figure 1). The main finfish species cultured is the exotic gilthead seabream (*Sparus aurata*); other species which have been used include the European seabass (*Dicentrarchus labrax*), the thinlip grey mullet (*Liza ramada*) and to less extent the orange-spotted grouper (*Epinephelus coioides*) and the local yellowfin seabream (*Acanthopagrus latus*).

All coastal regions in Oman have their own topographical and environmental conditions which will determine the type of culture methods that can be established. For marine cage culture projects, the most suitable sites are found in the Musandam Peninsula, an exclave of Oman separated from the rest of the country by the United Arab Emirates. The Peninsula has an area of 1 800 square kilometres and the governorate consists of four namely Khasab, Bukha, Daba Al-Bayah and Madha. This region has deep fjord-like inlets (known as “Khawrs”) which are suitable for marine cage culture. Currently, there are three private cage farming applications under evaluation in this region.

At present there are a number of rules and regulations that control the process of aquaculture site selection, farm licensing and environmental impact assessment (EIA) requirements for all aquaculture project including marine cage farms. The main regulation that regulates the aquaculture sector is the by-law for aquaculture and quality control of aquaculture products issued in 2004 by the Ministry of Fisheries. With regards to the farm sites these should not conflict with the activities of local fishermen and they should be located away from environmentally sensitive areas such as mangrove swamps, coral reef and turtles nesting sites. The selection process is overseen by a specific aquaculture committee headed by the Ministry of Fisheries and includes members of other relevant governmental authorities.

Protecting the environment is one of the main priorities for the Government and hence a special ministry was established for this purpose. There are different regulations concerning the protection of environment and some of these are related to the development of the aquaculture sector. According to the current laws, any aquaculture project should obtain an environmental permit before starting its operations. Furthermore, there is a special regulation that controls the issuance of environmental approvals for all commercial projects including aquaculture. In this regulation, aquaculture projects are classified under the category of projects that require a detailed EIA study although there are no specific requirements for such EIA studies. The existing requirements for EIA studies are general and many vary depending on the type of the project.

The environment regulations and EIA studies are enforced and effective. For aquaculture, there is a need to develop specific requirements and guidelines for EIA studies which cover all aspects of aquaculture effects on the environment and its interactions with capture fisheries and the surrounding environment.

BRIEF HISTORY OF MARINE CAGE AQUACULTURE IN OMAN

Marine cage culture activities started in Oman in 1997 by a research project conducted by the Ministry of Fisheries in cooperation with a private company. The project was carried out in Bandar Khyran area in Muscat Governorate (Figures 2). The main objective of this project was to test the viability of marine cage culture in Oman. Four small cages (14 m diameter) were used in the project (Figure 3). Two commercial marine finfish species were tested including the exotic gilthead seabream (*S. aurata*) and the endemic Sobaity (*Sparidentex hasta*). The juveniles for both species were imported from outside; the gilthead seabream from Greece and the Sobaity from the Kingdom of Bahrain.

Within 15 months, the gilthead seabream reached the marketable size (300–400 g), while the Sobaity attained up to 600 g in one year. The successful results certainly encouraged the private sector to invest in marine cage farming. This was reflected in the applications from different private companies to use the site and facilities of the research project and also in the applications to establish commercial marine cage culture projects on other parts of Oman.

In 2001, a private company invested in this site and increased the numbers and sizes of the cages. This was done through an agreement with the Ministry of Fisheries, where technical staff of the Ministry received training from the company. The Ministry favours a strong cooperation with the private sector as it believes that such cooperation will lead to a sustainable development of the sector.

The same company also exploited a further site in Muscat (Quriyat region). This project started with three finfish species, the gilthead seabream (*S. aurata*), the European seabass (*D. labrax*), the thinlip grey mullet (*L. ramada*) and later they experimented two local species, the yellowfin seabream (*A. latus*), and the orange-spotted grouper (*E. coioides*). In 2003, the company initiated a capture-based aquaculture activity by fattening the yellowfin tuna (*Thunnus albacores*).



Figure 1

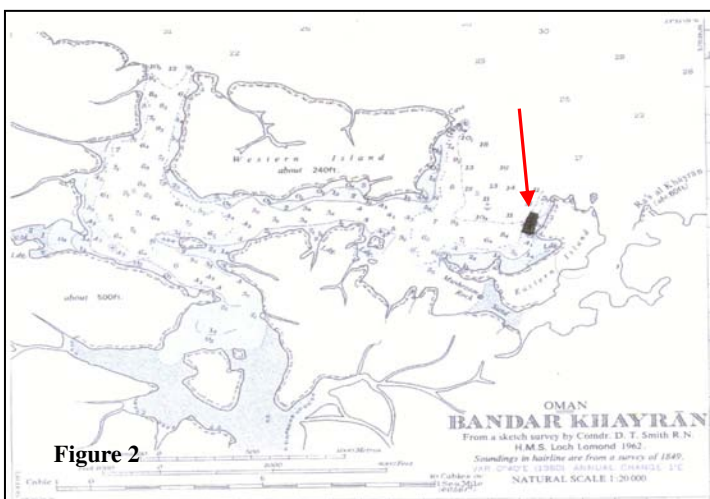


Figure 2

CURRENT SITUATION

Description of national coastline

Oman is located in the southeast corner of the Arabian Peninsula. It has more than 3 165 km of coast from Musandam in the north to Salalah in the south. It faces three seas: the Arabian Gulf, the Gulf of Oman and the Arabian Sea. Oman has 9 regions of which 6 are coastal ones (Figure 3). The total surface area of Oman is approximately 309 500 km², which comprises of the continental land and the main islands such as Masirah and Al-Halaniyat. Oman has about 11 topographical areas including mountains, coastal alluvial plains, pediplains and sand dune areas. There are two coastal alluvial plain in Oman; one in Al-Batinah region and the other in Salalah. These plains were formed from the deposition of wadis; mainly fine sand and granules.

The coastal shelf is narrow in the Musandam region and in the area from Muscat to Ra's Al-Hadd and in the south of the country around Salalah. Along these stretches of coastline the 30 m depth contour is just a few miles from the coast. In contrast, along much of the coast of Al-Batinah, Ash-Sharqiyah and Al-Wusta regions, the 30 m depth contour is not reached until 5–10 nm offshore and after 20 nm in the Gulf of Masirah in northern Al-Wusta.



Figure 3

Musandam in the north of Oman has a coast length of approximately 600 km, extending from Tibat in the Arabian Gulf to Daba in the Gulf of Oman (Salm, 1991). The Musandam Peninsula is formed of a series of precipitous peninsulas and headlands enclosing deep fjord-like inlets (Figure 4). This coast includes different type of beaches such as cliffed, rocky, gravel and sandy beaches. The major structural component of the coastline is the limestone cliffs. These cliffs reaching height over 240 m in some places and form about 66 percent of the total coastline (Salm, 1991).

This region is considered as one of the most suitable places for marine cage culture in the country (Al-Yahyai *et al.*, 2004). The region has numerous khawrs (fjords) among which Khawr Humzi, Khawr Habalyn, Khawr Shamm (Figure 5), Khawr Najd, Khawr Shisa. These kharws are protected from strong storm and are generally deep.

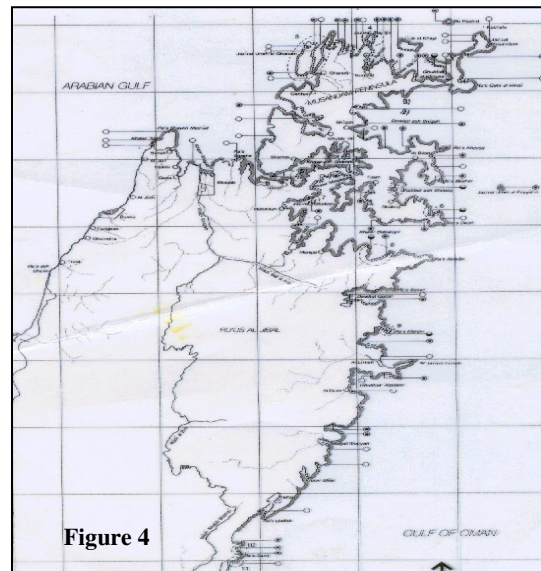
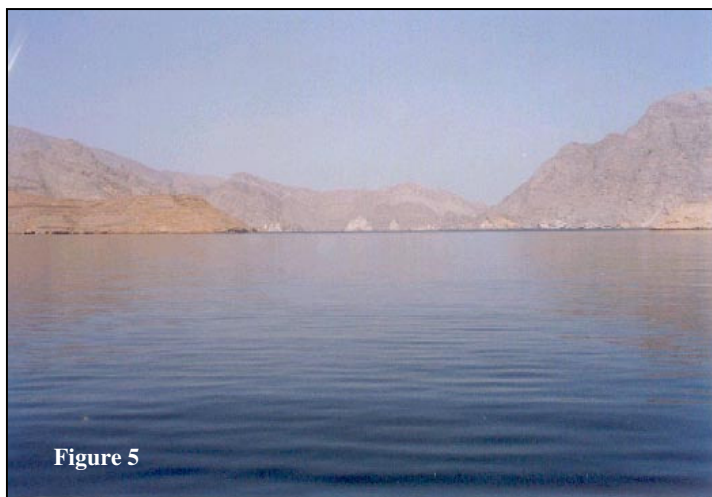


Figure 4

The coast of Al-Batinah region comprise a wide, fertile coastal plain formed of alluvial deposits leading to brown sandy beaches with occasional outcrops of beach rock (Salm, 1991). In general, the adjacent seas of this coastline are shallow and sandy. Establishing a marine cage farm in this area needs careful study and considerations for the site.

The Muscat Governorate is the capital of the country. Its coastline is characterized mostly by rocky shores with few sandy beaches. There are few protected areas along this coastline such as Bandar Khyran area where there used to be a marine cage culture project. The coast between Quriyat and Daghmar includes a large alluvial plain, which encompasses an extensive delta system and is itself boarded on the landward side by rocky mountain (Salm, 1991). Between Daghmar and Dibab, Fins and Tiwi, there are cliffed shores with scattered rocky reefs. From Dibab to Fins, the shoreline is backed by raised gravel terraces, with cobble or gravel beaches or rocky shores and few stretches of sandy beaches.

The coastline of Sharqiya region varies from one place to another. The coast from Tiwi to Qalhat is characterized by terraces, which are fringed by cobble or gravel beaches or rocky shores with some stretches of sand beaches (Anon., 1985a). This coastline is considered not favourable for land aquaculture development. It consists of cliffs of 5–10 m in height, or gravel beach exposed to strong wave action. The soil is bear rock in some instance, or mostly sandy with gravel and boulders. The distance between the sea shore and the mountain range is small and never more than a few hundred metres. This relatively quick topographical raise will not allow easy development of pond facilities. In the adjacent sea however, there are possibilities for establishing marine cage culture. Cluffed shores are also found in Khawr Al-Hajr, Al-Hadd and Ad Daffah. These cliffs are bordered by deep sea. Along this coastline, there are many areas of Khawrs such as Khawr Jrama and Khawr Al-Hajr. These kharws provide natural habitat for many species.



There are many sandy beaches, which are backed by low rocky mountain such as the ones in Ra's Al-Hadd to Al-Khuwaymah. The Arabian Sea starts from Ras Al-Hadd area (Sharquiya region) to Dhofar Governorate in the south. During the monsoon period (June-September), the Arabian Sea becomes very rough and its conditions may not favour the development of a marine cage industry.

Al-Wusta region has the second largest land area among Oman's nine regions, with the smallest number of inhabitants. This coastline comprise of different types of environments such as sandy beaches, coastal plains, rocky mountains, sand dunes, shallow near shore seabed with sand-rock substrates and deep rocky seabed (Anon., 1985b). There are many areas of environment interest along this long coastline among which Barr Al-Hikman and Mahout Island are the main areas. Barr Al-Hikman marks the transition from the high-moderate energy coast of the north to the moderate energy coast that extends south to Ra's Madrasah (Anon., 1992). Mudflats and clear lagoons around Bar Al-Hikman are home to large populations of migratory and indigenous bird species. There are also some khawrs areas along this coastline which is also characterized by a large free sabkha area. Very few protected areas along this coast may be suitable for marine cage culture.

Dhofar Governorate has a coastline that stretches for 560 km. It includes sandy beaches, rocky shores and cliffed areas. There are also groups of islands along this coast of which the Al-Halaniyat group of islands are the largest in Oman. The entire coast is exposed to heavy wave action. There are also a number of rocky-gravel plain areas along this stretch of coast such as the ones seaward of Jabal Samhan and in the areas of Sharbitat, Shuwaymiyah and Hasik.

The coastline is characterized by a chain of mountains (e.g. Jabal Qamar, Jabal Samhan, Jabal Qara) interspersed by long sandy beaches, the longest of which extend from Raysut to Mirbat, broken only by a rocky outcrop at Taqah (Barratt, 1984). Raised terraces of gravel and rock border the sea at Sharbitat, the western end of Shuwaymiyah and intermittently from Hasik to Mirbat. Most of the coastline from Raysut to border with Yemen is cliffed or has steep mountains. There are many khawr areas along this coastline especially surround Salalah area.

Salalah plain is a gently sloping alluvial outward plain formed by the depositing of weathered material worked from the adjacent mountains (Anon., 1985b). Alluvial materials are deposited in a sequence manner, coarser materials near the mountain and finer materials towards the coast. Marbat plain lies adjacent to Salalah plain, but it differs in its geomorphology. This plain is covered almost entirely by cemented alluvial terraces and heavily dissected metamorphic rock outcrops.

Dhofar is climatically different from the rest of Oman due to the effects of the monsoon rains which occur between June and September. Temperature is moderate, rarely exceeding 30 °C. Dhofar divides naturally into three areas: the coastal plain, the mountains and the desert region.

The strongest winds of the year comes at the time of the south-west monsoon from July-September, and the Arabian Sea coast experiences the heaviest wave action during this period. The Gulf of Oman is more protected from large swells and waves year round compared to the Arabian Sea. There has been only limited research into currents along the coast of the country, but the Oman Meteorological Department has good hydrographical, as well as meteorological, modelling capability and has run detailed predictions for seasonal current patterns around the coast.

Farmed and candidate marine species in cages

Currently, there is only one commercial marine cage farm operating in Oman. This project cultures the introduced gilthead seabream (*S. aurata*). The culture of this species was experimented by the aquaculture centre in 1997 and proven to be economically successful candidate. Table 1 shows the different finfish species that have been cultured in cages in Oman. Three species are exotic species and include the gilthead seabream (*S. aurata*), the European seabass (*D. labrax*), and the thinlip grey mullet (*L. ramada*). The seabass and mullet were introduced by the private company in year 2001 and imported with health certification produced by a certified laboratory outside the country. However, due to the encouragement of the government to use the local species, the company carried out culture trials using two local species, the yellowfin seabream (*A. latus*) and the orange-spotted grouper (*E. coioides*) by importing certified seed material obtained from a hatchery operating in Kuwait. The local yellowfin tuna (*T. albacres*) was experimented for fattening in 2003 and proven successful.

Table 1. Cultured species in marine cage culture in Oman

English name	Scientific name	Comments
Gilthead seabream	<i>Sparus aurata</i>	Research, commercial
Sobaity seabream	<i>Sparidentex hasta</i>	Research
European seabass	<i>Dicentrarchus labrax</i>	Commercial
Thinlip grey mullet	<i>Liza ramada</i>	Commercial
Yellowfin seabream	<i>Acanthopagrus latus</i>	Commercial
Orange-spotted grouper	<i>Epinephelus coioides</i>	Commercial
Yellowfin tuna	<i>Thunnus albacres</i>	Commercial

There are also other marine finfish candidate species for cage aquaculture in Oman such as Cobia (*Rachycentron canadum*), different species of groupers (*Epinephelus* spp.), the red seabream (*Cheimerius nufar*) and gold-lined seabream (*Rhabdosargus sarba*).

Supply of seeds and feeds

The seeds for all the cultured species are imported from outside the country due to the absence of local hatcheries for marine finfish species. Likewise the feed it is imported from outside the country.

Type and size of cages used

The marine finfish cage culture projects currently use cages made of high density polyethylene (HDPE) (Figures 6 and 7). These cage are of different size and capacity according to their uses. Some cages are of 14 m in diameter while most are of 20 m in diameter. The nets used are knotless type, polyimide treated with non-toxic antifouling substances. The depth of the net is usually around 6 meter.

Existing cage farms and applications

Currently there is only one existing marine cage farm in Oman located in Quriyat region (Muscat Governorate). This company relocated all of its cages from Bandar Khyran area to its present site in Quriyat region (Figure 8). The coordinates of the farm are given in

Table 2. Eight cages are actively used in the farm. Apart from this operation at present there are three applications for establishing marine cage farms all in Musandam Governorate in the north of Oman.



Figure 6



Figure 7

Table 2. Coordinates of the marine cage farm in Quriyat (Muscat Governorate)

Region	Wilya	Site	GPS reading	
			N	E
Muscat	Qiryat	Qiryat	23 17 00	58 56 17
			23 16 79	58 56 33
			23 17 00	58 60 60
			23 17 17	58 56 42



Past and current production volumes per species

The commercial production from marine cage farm in Oman started in year 2003 (Table 3). European seabream dominate the production throughout the pas years. At the end of year 2007, the company stocked new shipment of European seabream fingerlings in Quriyat site that was imported from Kingdom of Bahrain with a health certificate.

Table 3. Commercial production of cage aquaculture in Oman

Species	2003	2004	2005	2006
Gilthead seabream	331	460	180	81.7
European seabass	13	27	-	-
Thinlip grey mullet	8	-	-	-
Yellowfin seabream	-	13	-	-
Yellowfin tuna	-	14	-	32
Orange-spotted grouper	-	0.222	-	-
Total	352	515.2	180	113.7

CONSTRAINTS & OPPORTUNITIES FOR MARINE CAGE CULTURE DEVELOPMENT

Development of aquaculture in Oman will likely provide opportunities to increase fish production, export revenues and create coastal employment. There are numerous opportunities which would encourage and enhance the development of marine cage culture in Oman, and these include:

- stable government;
- national strategy of economic diversification
- availability of investors ready to invest in the sector;
- availability of suitable sites for cage culture including sheltered inlets with deep waters;
- clean and unpolluted seas;
- availability of infrastructure along the coast;
- availability of local species with good potential for cage farming;
- strong seafood processing sector;
- good access to main markets in the European Union and in Southeast Asia;
- availability of trained human resources (Sultan Qaboos University/Fishermen Training institute); and
- availability of a modern and fully equipped fish quality control centre.

In contrast, there are also a number of constraints that may slow down the development of marine cage culture in Oman, and these include:

- lack of support industries such as feed plants and equipment manufacturers;
- lack of commercial hatcheries;
- large portion of the coast exposed to wave action especially during the monsoon season along the Arabian Sea;
- possibilities of oil spills due to the busy shipping routes through the Strait of Hormuz or from coastal ports and industry; and
- highly fluctuating air temperatures and high water evaporation rates which can induce water temperatures and salinities to rise above acceptable levels for many farmed species.

INSTITUTIONAL REQUIREMENTS FOR ESTABLISHING & OPERATING CAGE FARM

Site selection

Currently, a private company or investor that wishes to develop a marine cage farm must first identify the site where to locate the farm. General information on potential sites, environmental (salinity, dissolved oxygen, etc.) and meteorological data can be obtained from relevant authorities. These authorities include the Aquaculture Centre, the Marine Sciences and Fisheries Centre (Ministry of Fisheries) and the Directorate General for Civil Aviation and Meteorology (Ministry of Transport and Communications).

There are no specific guidelines for selecting site for marine cage farm, but there are few conditions that deal with the issue of site selection in the by-law on aquaculture and quality control of aquaculture products (see Annex 1). According to these conditions, the selected site should not interfere with the activities of local fishing communities and away from natural conservation areas such as mangrove and coral reefs. The site should also be at a reasonable distance from navigation routes. Considerations should also be giving to marine safety such as materials to be used, warning signals and lights.

The Ministry of Fisheries established an aquaculture technical committee in 1996 to review aquaculture projects applications submitted by the private sector. This committee includes members from different authorities including the Ministry of Fisheries, Ministry of Housing, Ministry of Transport and Communications, Ministry of Tourism, Ministry of Trade, Ministry of Environment and Climate Affairs and the Oman Chamber of Commerce and Trade. This committee determines the suitability of any site submitted by an investor. For marine cage culture projects, the Ministry of Transport and Communications will provide information on navigation routes near the proposed site, if any, and determine the conditions to be followed by the investor with regards to marine safety issues.

Realizing the importance of identifying suitable sites for aquaculture, the Ministry of Fisheries has initiated a project to produce a detailed atlas where potential aquaculture sites will be indicated. The atlas will include information on environmental data, size of the sites and other relevant data. Sites for marine cage culture will be indicated in the atlas.

Farm licensing

According to the current regulation (By-law on aquaculture and quality control of aquaculture products), the establishment of fish farms shall not be allowed unless the necessary licences are obtained from the competent authority (Ministry of Fisheries). Clear procedures exist for aquaculture applicants from the early submission stages to the final approval of the licence. These procedures are illustrated in Annex 2. There are eight articles in the by-law on aquaculture that determine the process for obtaining an aquaculture licence including marine cage projects (see Annex 3). These articles also determine the conditions for the licence and the time required to obtain one. When the application is

submitted by an investor and evaluated by all members of the aquaculture committee, a preliminary approval will be issued based on a number of criteria including the financial strength of the company, acceptance of the applicant for the monitoring programme, and clearance that there are no overlapping interests for the specific site by the local fishing communities.

The final permit for the aquaculture project shall contain information such as establishment's name and address, location and its area, type and quantities of the cultured organisms, date of issue, duration, and type of licensing. The by-law also determines the regular licence fees for all aquaculture projects including marine cage farms (see Annex 4). When the operations start, there are other licensing required by investors such as those for importing fish fingerlings, feeds, drugs and equipments. At present the Ministry of Fisheries will coordinate with other relevant ministries to obtain all the necessary permits.

Environmental Impact Assessment (EIA)

Environmental permit

Protecting the environment is a priority for the Government of Oman. Therefore, the Ministry of Environment and Climate Affairs (MECA) was established as the governmental authority responsible for the protection of environment. There are numerous laws focused on the protection of the environment. The law on the Conservation of the Environment and Prevention of Pollution is the main one and provides the framework for environmental protection in Oman. The law was issued by the government in 1982, and subsequently amended by the Royal Decree No. 114/2001 on 14/11/2001. Many regulations and ministerial decrees have been issued by MECA for the enforcement of this main law. According to this law, no establishment of any source or area of work shall be started before obtaining an environmental permit confirming its environmental soundness. This also includes aquaculture projects.

The Ministerial decision 187/2001 for organizing the Issuance of Environmental Approvals and the Final Environmental Permit is an important regulation and it includes aquaculture projects (see Annex 5). This regulation details the necessary requirements and the approval system for environmental impact studies (EIA). In this regulation, all industrial/commercial establishments have been classified into three categories according to the materials used in the production process, production capacity and the likely degree of their impact to the environment. Each category has its own environmental conditions according to the level of environmental impact arising from its construction and operation. Aquaculture projects are classified in the third category, which requires a detailed EIA study.

According to the regulation, the owner of an establishment (including aquaculture facility) shall apply to MECA for environmental approval. The Environmental Impact Assessment (EIA) study will be submitted with the application and the ministry official will then inspect the proposed site to determine the environmental conditions that must be fulfilled. Only at this point the preliminary approval is given to the establishment to commence the construction process. The approval will include specifications on environmental conditions to be fulfilled prior to starting the operation and is valid for one year and renewable for a similar period. The final environmental permit is given to the establishment after fulfilment of the conditions stated in the preliminary environmental approval and shall be valid for two years and renewable for a same period or other specified period.

There are fees against the issuance of the environmental approval and the final environmental permit. Depending on its nature of activities as evaluated by the competent authority, the establishment is bound to conduct an Environmental Audit (EA) by specialized companies approved by the competent authority according to the requirement of the ISO 14000 series for environmental management system, every two years from the date of receiving their final environmental permits.

General and technical guidelines for environmental permit

There are no specific guidelines for EIA study for aquaculture. The existing guidelines are rather general and were prepared by MECA. Aquaculture activities have been included in marine and coastal projects which also includes commercial ports, fishing harbours, marine bridges, marinas and clubs and artificial lakes. The general and technical requirements for this group of projects are listed in Annex 6. Among the various requirements there is one that states that aquaculture projects should use local species as far as possible and to avoid natural areas such as coral reefs, khawrs, and mangrove areas.

EIA study

According to the requirements established by MECA, there are specific criteria for projects that require a detailed study on environmental impact. These criteria are:

- Projects with considerable adverse impacts on the social or natural environment or those which have impacts on an area larger than the project site.
- Large projects with major capital investment or manpower and projects which cover large areas.
- Projects which use large quantities of chemicals, hazardous substances or that run operations and activities which might cause health hazards.
- Projects with potential adverse impacts on natural, cultural, social, historical, heritable, aesthetic, scenic or industrial resources.

The EIA process is based on the following guiding principles:

- EIA is a process to help decision makers to protect, conserve and manage Oman's environment according to the principle of sustainable development, thereby achieving or maintaining human well being, a healthy environment and a sound economy.
- The EIA process should ensure that the individual, company or government agency proposing a project considers its effect on the health, economy and culture of the surrounding communities as well as its impacts on the air, land and water.
- The EIA must be applied as early as possible in a project's planning stage and before irrevocable decisions are made.
- Public information as an important component of an open and balanced EIA process.

There are few criteria that can be applied to determine the appropriate level of EIA study. These include type and magnitude of the project, location and sensitivity and likelihood, nature and magnitude of the potential impacts. In order to evaluate the nature of the impacts of the project, there are several aspects that need to be considered and these include; project type, site sensitivity, possibility of irreversible destruction of nature habitats, cumulative environmental impacts, sustainable use of renewable resources, impacts on human health and safety and effectiveness of mitigation measures.

The applicant for any commercial project including aquaculture should consult MECA to establish the scope of the study and to focus the study on significant issues and concerns. The key features of EIA study is illustrated in Annex 7.

The MECA will review and evaluate the EIA to ensure that all significant impacts are addressed and conclusions of the EIA study are derived through the required planning steps. The complete EIA study documents become part of the application package for an environmental permit. After the review is completed the Ministry will either:

- accept the conclusion of EIA and issue an Environment Permit;
- request a further study; or
- request re-application for an alternative proposal.

The data and information that should be included in the EIA are outlined in Annex 8. This information describes environmental assessment, project site and its environment, different impacts and mitigation measures.

Environmental monitoring programming

Currently, there is no clear separate monitoring programme for aquaculture. A monitoring programme is under preparation by the Environmental Monitoring Section of the Aquaculture Centre. The Fish Quality Centre under the Ministry of Fisheries established in 1998 is responsible for increasing the quality of exported Omani marine products. The centre also conducts regular inspection visits to fisheries companies which include aquaculture projects to ensure that they comply with national and international regulations for quality. All company should obtain a quality control number before it can start its operation. The process for this number includes application of a HACCP system.

In order to meet the international standards required for the aquaculture export products, the Fish Quality Centre established a new laboratory for residual analysis. This laboratory is equipped with LC-MS/MS for the analysis of banned antibiotic like Chloramphenicol, nitrofurantoin metabolites, tetracyclines and sulfa drugs. This Centre also prepared a national residue monitoring plan in conformity with the European Council Directive 96/23/EC and requirements for submission of residue monitoring programme.

INSTITUTIONAL DEVELOPMENT POLICY

National plans and targets

The Ministry of Fisheries has prepared National Strategic Plan for Sustainable Aquaculture Development in the Sultanate of Oman in cooperation with the Food and Agriculture Organization of the United Nations (FAO, 2007). The overall purpose of this Strategic Plan is to provide guidance to the government on public and private action that will promote the development of a viable and sustainable aquaculture sector, in a way that is consistent with national priorities. This strategic plan outlines the opportunities and constraints in the aquaculture sector in Oman. It also recommends the suitable species and culture methods for the country based on the local conditions.

The aim of the Ministry of Fisheries is to develop the aquaculture sector in a competitive and sustainable manner in harmony with the social, economic, cultural and historic values of the country. The development objectives of this sector include:

- Develop an aquaculture industry that ensures food security to the population, provides employment, generates export earnings and contributes to diversification of the economy.
- Ensure economic and environmental sustainability of the developing aquaculture industry, with good environmental stewardship and social equity.

According to this strategic plan, the guiding principals (or policy framework) are:

- Government shall encourage responsible development of aquaculture and establish aquaculture specific policies and regulations.
- Commercial development of aquaculture is the responsibility of the private sector. The public role is to provide an enabling, transparent and efficient regulatory and supporting framework for responsible development.
- Aquaculture is a legitimate user of land and water resources; it should have equitable access to these natural resources.
- Streamlining and coordination of government policies and regulations and a transparent decision-making process are critical for success.
- A decision-making process that is transparent, efficient and participatory is necessary to avoid conflict and facilitate compliance.
- Development should employ a precautionary approach to avoid and minimize environmental impacts and promote integration with the ecosystem.
- Development projects should be assessed according to agreed-on environmental standards in line with existing environmental regulations of the expert agency.

This strategic plan recommends the following strategic steps to promote sustainable development of aquaculture in Oman:

- Create an appropriate legislative and regulatory framework.
- Create an enabling administrative framework.
- Support commercial aquaculture development.

Subsidies and financing policies

Currently, there is no policy for aquaculture subsidies. With regards to financing, there are soft loans for companies working in fisheries sector including aquaculture company. Authorized company can apply for this type of loan from the Oman Development Bank. The amount of loan depends on the capital of the company and its location (inside or outside the Muscat Governorate).

Production for domestic markets or exports

The marketing of the production depends on the company policy and its objectives. Most of the previous commercial production from marine cage culture project in Oman was for export and lower quantity products were destined for domestic market.

Employment and gender issues

The current marine cage operation employs a total of 14 persons of which eight are Omani. The Omani cover both administrative as well as cage site jobs. The Government encourages Omanization in all the projects from different commercial sectors. The Ministry of Manpower is the main governmental authority responsible for proposing and implementing manpower general policies in line with the state economic and social objectives. The Ministry also drafts laws regulating the labour market and the vocational training sector and issues regulations and decisions to ensure their implementation for the protection of the national labour force. The Ministry is also responsible to develop training curricula according to the approved vocational criteria and levels, awarding qualifications, encouraging on-the-job-training and following graduates to ensure that they utilize the available job opportunities.

The Ministry of Labour has established a national labour force register which includes all relevant data and information on the labour force and thoroughly monitors data and information changes. There are plans to increase the percentage of Omani people in all production and services sectors. These plans were prepared in cooperation with the private sector.

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National regulation concerning site selection

Article (13): Preliminary approval for all commercial aquaculture projects shall be granted based on the following:

- The financial ability of the establishment to implement the project.
- Acceptance of the applicant to follow-up and inspection visits of government staff to ensure that the applicant is committed to the technical guidelines dictated by the competent aquaculture authority.
- There are no negative interactions with the activities of local fishermen, and there are no adverse impacts on natural conservation areas, mangroves and coral reefs.
- The water inlets for land-based projects shall be far from the drainage outlets to water pollution.
- Commercial aquaculture permits shall not be provided for sites located in proximity of busy navigational routes.
- Marine safety conditions regarding materials employed, the used of appropriate warning signals and lights in the project shall be taken due consideration.

**Procedures for obtaining licence for aquaculture project
(including marine cage farm)**

Competent authority	Directorate General of Fisheries Research, Ministry of Fisheries
Documents required	<ol style="list-style-type: none"> 1. Application letter requesting to establish an aquaculture project addressed to the Directorate General of Fisheries Research (Head of Aquaculture Committee). 2. Application form. 3. Preliminary overview of the project. 4. Feasibility study. 5. Environmental Impact assessment (EIA) study. 6. Registration documents of the company. 7. Other documents that may be required following the evaluation of feasibility study or in case government fund are required.
Steps	<ol style="list-style-type: none"> 1. Provide documents 1, 2 and 3 to the Directorate General of Fisheries Research (Head of Aquaculture Committee). 2. The application and proposed site will be evaluated by the technical staff of the Ministry. 3. In case there are no technical objections on the application and proposed site, the application will be forwarded to the Aquaculture Committee. 4. In case of an approval from the Aquaculture Committee, the applicant will be notified with the preliminary approval along with conditions from each government authority. 5. The applicant should then submit documents 4, 5, 6 and 7 to the Aquaculture Committee for further evaluation. 6. It may be required to adjust these studies according to the comments of Committee's members. 7. A recommendation will be forwarded to the Minister of Fisheries for final approval of the proposed aquaculture project.

Regulations concerning farm licensing in the aquaculture by-law

- Article (12):** The establishment interested in establishing an aquaculture project shall submit its application to the competent authority using the specifically designed application form for this purpose. The application shall contain the following:
- Name of the region and of the willayat (district), the exact locating of the proposed project site, its size of the area, and information on how the land is obtained.
 - Type of the aquatic organism to be farmed, source of the seed material and quantities required.
 - Expected starting date of the project, duration and estimated costs.
 - Quality of water to be used in the project, quantity and source and method of discharge if the project is land-based.
 - Type of aquaculture system (fixed, movable or floating cages).
 - A recent socioeconomic feasibility study if the project is intended to be of commercial size.
- Article (13):** Preliminary approval for the commercial aquaculture shall be granted based on the following:
- The financial ability of the establishment to implement the project.
 - Acceptance of the applicant to the follow-up and inspection visits of the Ministry personnel to make sure that the applicant is committed to the technical guidelines dictated by the competent authority in aquaculture.
 - No effects on local fishermen from the project, in addition to the natural conservation areas, mangroves and coral reefs.
 - The water inlets for land-based projects shall be far from the drainage outlets to avoid pollution.
 - Commercial aquaculture permit shall not be provided for sites closer to the crowded navigational routes.
 - Marine safety conditions regarding material used, warning signals and lights in the project shall be taken into consideration.
- Article (14):** The establishment that has obtained a preliminary approval for its application shall be responsible to obtain all required permits for the execution of the project from the relevant and competent authorities.
- Article (15):** The preliminary approval shall be cancelled if the establishment fails to obtain the required permits from the relevant and competent authorities within one year for experimental aquaculture and two years for commercial aquaculture projects.
- Article (16):** The establishment shall be notified officially in written in the event of any contravention of its operations; the competent authority shall cancel the permit, if the establishment fails to resolve the contravention in one month.
- Article (17):** The aquaculture permit shall contain the following information:
- Establishment's name and address.
 - Exact location and its surface area.

- Species and quantities of cultured organisms.
- Date of issue, duration, and type of licensing,
- Any other project-specific information required by the competent authority.

Article (18): The experimental aquaculture period shall be for 2-years, while commercial undertakings will be granted periods of 10-years. These periods can be extended.

Article (19): The competent authority will issue annually renewable 1-year permits for experimental and commercial.

Fees fixed on fish farms licences

Fee	Amount in omani rials
<p><u>First</u> – <u>Experimental aquaculture:</u></p> <ul style="list-style-type: none"> - Fees for preliminary approval. - Fees for issuance or renewal of the permit. 	<p>5 rials.</p> <p>20 rials.</p>
<p><u>Second</u> – <u>Commercial aquaculture:</u></p> <ul style="list-style-type: none"> - Fees for preliminary approval. - Fees for issuance or renewal of the permit. - Supervision fees. 	<p>10 rials.</p> <p>40 rials.</p> <p>One percent from the total value of the annual production starting after 5 years from production, calculated from the actual prices of the fish specified in the executive by-law of the Marine Fishing Law.</p>
<p><u>Third</u> – <u>Other fees:</u></p> <ul style="list-style-type: none"> - Fees for transferring the permit. - Fines for late renewal of the permit. - Fees for compensation 	<p>10 rials.</p> <p>Two rials for the experimental project permit, 4 rials for the commercial project following 60 days from the expiry date of the permit.</p> <p>5 rials.</p>
<p>One rial for a Permit Application Form.</p>	

**Regulation for organizing the issuance of environment approvals
and the final environment permit**

Article (1): In the application of the provisions of these regulations, the words and phrases shall have the following meanings unless stipulated otherwise:

Environmental approval shall include:

– Preliminary environmental approval:

To be granted to the establishment to commence the construction process and the approval shall include specifications environmental conditions to be fulfilled prior to starting operation and shall be valid for one year and renewable for a similar period.

– Temporary environmental approval:

To be granted to industrial establishment located outside an industrial areas specified by the competent authorities and to projects complementary to infrastructure ones. The approval, in all cases, shall be valid for one year and renewable for similar periods until the existence of an industrial area or completion of the infrastructure project as appropriate.

– Environmental permit to infrastructure projects:

To be granted to infrastructure projects not requiring follow-up after completion of the construction. The approval shall be valid for one year and renewable for similar periods until completion of the project.

– Final environment permit:

To be granted to the establishment after fulfilment of the conditions stated in the Preliminary Environmental Approval and shall be valid for two years and renewable for a similar period or other specified periods.

Article (2): The establishments, subject to the provisions of these regulations, shall be classified into categories according to the materials used in production, production capacity and the degree of their impact on the adjacent environment as indicated in the attached annex. Every category stated in the said annex shall have its own environmental conditions according to the level of environmental impact arising from its construction and operation.

Article (3): The owner of an establishment shall apply to the Ministry on the form approved by the Ministry and in addition enclose an environmental impact study prepared by a consulting office approved by the Sultanate, if required by the Ministry.

Article (4): The Ministry official shall as a preliminary step toward issuance of the environmental approval inspect the proposed site to determine the environmental conditions that must be fulfilled.

Article (5): The owner of the establishment shall be bound to implement the required conditions and shall inform the Ministry of the same and after ensuring that all conditions were implemented prior to issuance of environmental approval or final Environmental Permit.

Article (6): Fees against the issuance of the environmental approval and the final environmental permit as per the attached table shall be collected.

Article (7): The establishment mentioned in the attached annex if the nature of their activities so require – as evaluated by the Ministry – shall be bound to conduct an Environmental Audit (EA) by specialized companies approved by the Sultanate according to the requirements of the ISO 14000 series for environmental management system, every two years from the date of receiving their final environmental permits.

Article (8): Without prejudice to the penalties stipulated by the mentioned Law on Conservation of the Environment and Prevention of Pollution, the Ministry may close down the establishment if the activity is practiced without environmental approval or final environmental permit or after their expiry dates.

Annex - Dividing the establishments into categories

Category One

- 1 Small block factories (less than 10 000 tonnes)
- 2 Carpentry, blacksmith and aluminium workshops
- 3 Flour and spice mills
- 4 Ready made clothes factories
- 5 Tissue paper industry
- 6 Foodstuff and coffee packaging (less than 500 tonnes)
- 7 Tissue paper factories (cutting-up to 2 million packets)
- 8 Water filtration and distilled water (less than 10 million litters)
- 9 Furniture factories
- 10 Bakeries and sweets manufacturing (less than 1 000 tonnes)
- 11 Ice plants (less than 5 000 tonnes)
- 12 Gas cylinder storage and sale
- 13 Car wash and oil change workshop
- 14 Small poultry farms
- 15 Small printing press

Category Two

- 1 Chemical plants
- 2 Pharmaceutical factories
- 3 Detergents factories
- 4 Marble, tiles and ceramic plants
- 5 Oil and gas projects
- 6 Power stations projects
- 7 Textile and spinning factories
- 8 Quarries
- 9 Plaster production
- 10 Perfumes and air fresheners
- 11 Petrochemical plants
- 12 Aluminium factories
- 13 Chalk plants
- 14 Water purification and desalination stations
- 15 Organic fertilizers
- 16 Tanning projects and leather industries
- 17 Crushers and screens
- 18 Mining
- 19 Large block factories (10 000 tonnes and more)
- 20 Large-scale printing press (3 000 tonnes and more)

Category Three

- 1 Poultry farms
- 2 Water treatment stations
- 3 Slaughter houses
- 4 Dairy production
- 5 Marine clubs, harbours and bridges
- 6 Artificial lakes
- 7 Water supply networks
- 8 Storage and recharge dams
- 9 Livestock sheds
- 11 Agriculture production and animal fodder
- 12 Fisheries packaging
- 13 Commercial and fishing ports
- 14 Fish farming
- 15 Roads
- 16 Commercial and residential complexes
- 17 Hospitals and health centres
- 18 Permanent and temporary worker's camps
- 19 Petrol stations

Table - Issuance of environmental approvals and the final environmental permit fees

No.	Type of activity	Fees in omani rials
1	Preliminary Environmental Approval:	
	Category One	3
	Category Two	5
	Category Three	7
2	Temporary Environmental Approval:	
	Category One	3
	Category Two	5
	Category Three	15
3	Environmental Permit for Infrastructure Projects	
4	Final Environmental Permit	
	Category One	5
	Category Two	10
	Category Three	30

General and technical requirement regarding environmental impact assessment of marine and coastal projects group

This group includes the following projects: commercial ports and fishing harbours, marine bridges, marinas and clubs, aquaculture, artificial lakes, and other projects specified by the Ministry*

General requirements that apply to all projects listed within this group

- The applicants should submit the completed form for Environmental permit and if necessary attach an Environmental Impact Assessment Study (EIA).
- Submission of a letter from the project owner.
- Submission of the project design (all concerned government approvals shall be incorporated along with the application).
- The applicant/owner is fully legally and financially responsible for any environmental impacts during construction, operation and post-closure phase of the project, including cost of mitigation measures, created by the actions or lack of action of its employees, contractors, subcontractors, payment of compensation, settlement of claims, etc.
- If possible, the company should avoid locating the project in areas of dense vegetation.
- If applicable, the company shall notify the Air and Noise Pollution Section of the Ministry on the intention of using explosives.
- The company should ensure that the proposed location comply with coastal set backs specified in the Ministry's regulation.
- The applicant should provide the designated Ministry's staff with unrestricted access to the project site to ensure that all relevant environment impacts of the projects are being considered.
- The company shall collect solid waste and dispose of it on sites approved by the local Municipality.
- The company shall ensure that domestic wastewater is treated and discharged in accordance with the Ministry's regulations.
- The company shall submit for review and approval a monitoring reporting programme that should include but not limited to relevant environmental statistics, information about spills, progress of the project and implementation of mitigation measures.
- The company shall control construction dust with water spraying or other method approved by the Ministry.
- The company shall collect spent oil in sealed drums and store them in concrete lined sites.
- Based on the nature of the project and its location the Ministry may include additional requirements.

(*) Ministry refer to the Ministry of Environment and Climate Affairs

Technical conditions for aquaculture

- If applicable, the company shall utilize in its breeding programme only fish indigenous to Oman.
- If applicable, the company shall submit a certificate stating that imported fish species are free from any diseases.
- The company shall not dispose at sea any fish waste without prior approval of this Ministry.
- Aquaculture projects shall not be established in khawrs, mangrove area, coral reefs and other environmentally vulnerable areas.
- Herbivorous species will be used as much as possible.
- Based on the nature of the project and its location the Ministry may include additional requirements.

Key features of environmental impact assessment study

Scoping

- Specifying the component of the proposed project and the environmental impacts that should be included in an EIA study.
- It includes determination of the environmental impacts to be mitigated and residual effects that are critical to make decision regarding the project.
- During scoping, the proponent in consultation with the Ministry should determine who is interested in the project, what their concerns are, and how the concerned parties should be involved in EIA.

Developing an EIA

- A scoped EIA should include the following elements which should be properly documented:
- Project description,
- Site description and environment-baseline study,
- Evaluation of the project, and
- Mitigation measures and risk assessment.

Project Description

In the project description, the proponent should describe relevant parts of the project components and activities, including:

- Location (using maps of appropriate scale),
- Physical layout and design,
- Size and capacity,
- Pre-construction activities,
- Construction plans and scheduling,
- Staffing and support,
- Facilities and services,
- Operating procedures and decommissioning plans,
- Required off-site activities or projects,
- Estimates of the types and volumes of solid and liquid waste and gaseous emissions, and
- Life span of the project, etc.

Site description and environment-baseline study

The description of the site should identify the most important environmental features of the study area and explain the reasons for selecting geographical limits of this area. The proponent should focus only on those elements of the environment that are relevant to the project. Before any assessment of future impacts can be made, the description must identify the existing physical, biological, social and legal characteristics of the site and its environment. This work is called baseline study. The baseline study should involve gathering and evaluating information from existing sources and collecting field data. The existing sources of information may include database, reports, experts from government organization, previously developed EIA, indigenous people (Traditional Ecological Knowledge), local community, industry and academia, aerial photos and satellite imagery. New information can be acquired through fieldwork, interviews and monitoring.

Evaluation of project's environmental impacts

At this stage, the proponent should use information about the project and the existing environment at the time of the study and identify and assess any potential environmental impacts. The proponent should also compare the site and timing of the project activities with the local sensitivities, seasonal activities and availability of the impacted elements of the environment (population of endangered species, limited supply of resources, available land, etc.). Types of impacts to be evaluated include:

- Cumulative and indirect environmental impacts.
- Impacts on socioeconomic conditions.
- Impacts on physical and cultural heritage.

The proponent should propose and evaluate reasonable alternatives to the project and their impacts. While evaluating the environmental impacts, the proponent should also determine whether the environmental impacts are harmful, significant and likely.

Mitigation measures and evaluating associated risks

The proponent should identify technically and economically feasible methods to avoid or reduce negative impacts and enhance positive effects. The following approaches can be used to mitigate likely significant harmful impacts:

- Direct prevention – by avoiding sensitive areas.
- Reduction – by adjusting work schedules, pollution control devices, changes in design, etc.
- Restoration and remediation measures – by removing temporary roads, re-grading, re-planting, establishing artificial reefs, relocating of coral, site cleanup, etc.
- Compensation-financial or in-kind payments to affected people to compensate them for loss of use or enjoyments.

The proponent should develop in consultation with the Ministry a follow-up programme for monitor efficiency of mitigation measures.

Final assessment

The proponent should evaluate through a net effect analysis, each project alternative or part of a project alternative in light of its advantages and disadvantage. The analysis should include a description of residual impact remaining after all mitigation measures are applied.

Data and information to be included in the environmental impact assessment study

Information describing the EIA

- Scope of the project and scope of the EIA

Information describing the project

1. Purpose and physical characteristics of the project including details of proposed access and transport arrangement and members to be employed and where they will come from. This should also include:
 - technological options
 - landscaping
 - design
 - project location options
 - infrastructure and utilities
 - air emission sources/data
 - size, construction, and appearance of building and installations
 - all anticipated discharge to the environment
 - time scale and schedule of the project
 - location and project layout plans, maps, diagram and photographs
2. Land use requirements and other physical features of the project:
 - existing land use
 - land-take during construction
 - land-take during operation
 - land-take after use has ceased
 - land-take reserved for future development
 - land-take for ancillary development, housing and recreation
 - land-take for new roads, amenities, screen planting and bunting walls
3. Production processes and operational features of the project:
 - i) Type and quantities of raw materials, energy and other resources consumed.
 - ii) Details of types, locations and land use requirements (including access roads) of all natural resource requirements and time-scale of consumption:
 - During construction, including extraction/production of aggregates, quarrying, borrow pits, etc.
 - When operational including raw materials, especially minerals used as part of the process.
 - iii) Residual and emissions by type, quantity, composition and strength including:
 - discharge to water
 - emission to air
 - noise-day and night during construction and operation
 - vibration
 - light (i.e. effects on turtles for instance)
 - radiation and heat emission during day and night

- deposit/residues to land and soil
- iv) Methods of transportation, handling and storage of raw materials, chemicals, fuels and final products.
 - v) Details of generation, handling, storage, management and disposal of toxic and hazardous wastes.
 - vi) Details of types, handling and disposal of radioactive materials.
4. Main alternative sites and processes considered, where appropriate and reasons for final choice.
 5. Any other information relevant to the project.
 6. Annexes should include the following:
 - i) Process flow-diagram indicating points of effluent discharge and nature of emissions to atmosphere from various point sources, including noise and solid and hazardous waste generation,
 - ii) Estimated air emission and their predicted levels of concentration from all significant sources,
 - iii) Composition, characteristics and quantification of all envisaged industrial and domestic effluent discharge; atmospheric emission and solid and hazardous wastes including provision for, and impact assessment of their disposal locations and practices in accordance with legislation,
 - iv) List of machinery with noise level,
 - v) Flow-diagram of wastewater treatment systems,
 - vi) Design details and calculations of stack/chimney (if any),
 - vii) Details of other modelling studies (if any), and
 - viii) List of chemicals and raw materials with quantities and data sheets for the chemicals.

Information describing the site and its environment

Physical features

1. Population-proximity and numbers,
2. Flora and fauna (including habitats and species) - in particular protected species and their habitats,
3. Soil – agricultural quality, geology and geomorphology,
4. Water aquifers, watercourses, shoreline and marine resources and including any existing discharge their type, quantity, composition and strength,
5. Air, climatic factors, air quality, noise emissions, odours, dust, etc.,
6. Architectural and historic heritage, archaeological sites and features and other materials assets,
7. Landscape and topography, and
8. Recreational uses.

Legislative framework

The information under this section should include:

- All statutory designations such as national nature reserves, sites of special scientific, areas of outstanding beauty, etc., and
- References to all relevant regulations/Ministerial Decisions and local and national planning policies applying to the site and surrounding area.

Assessment of effects

This section should include direct and indirect, secondary, cumulative, short-, medium- and long-term, permanent and temporary, positive and negative effects of the development.

1. Impacts on human beings, buildings and man made features

- Changing in population arising from the development and consequential environmental impacts
- Visual impacts of the development on the surrounding area and landscape
- Levels and impacts emissions from the development during normal operations
- Impacts of the development on local roads and transport
- Impacts of the development on buildings, the architectural and historical heritage, archaeological features and other human artefacts

2. Impacts on flora, fauna and geology

- Loss of, and damage to habitat, trees and other plant and animal species including marine
- Loss of, and damage to geological, paleontological and physical features
- Loss of plants or trees constituting a visual asset the landscape
- Existing environmental effects that may already have put the fauna and flora at risk
- Other ecological consequences

3. Impacts on land

- Physical effects of the development, e.g. change in local topography, effect of earth moving on stability, soil or breach erosion, etc.
- Impact of cut and fill, deep foundations and piling on the natural drainage
- Impacts of chemical emissions and deposits on soil of sit and the surrounding land
- Land use/resource impacts

4. Impacts on water

- Impacts of the development on the drainage pattern of the area
- Changes to other hydrographical characteristics, e.g. ground water level, watercourses, flow of underground water, pollution, etc.
- Impacts on coastal, estuarine hydrology
- Impacts of pollutants and waste on water quality

5. Impacts on air and climate

- Emissions from existing and approved future sources of air pollution that may have already created or will create stress on the environment
- Levels and concentrations of chemical emissions and their environmental impacts
- Impacts of particular matter on human, plants and other elements of the environment
- Offensive odours
- Any other climatic impacts

6. Other direct and secondary effects associated with the project

- Impacts from traffic related to the development
- Impacts arising from the extraction and consumption of materials (especially minerals such as stone, aggregates, sand, clay, etc.), water, energy and/or other resources required by the development
- Impacts of other development associated with the project, e.g. new roads, sewers, housing, power lines, etc.
- Impacts specific to the construction period such as construction camps
- Impacts of association of the development with other existing or proposed development
- Any other secondary impacts

Environmental Management Plan (EMP) – Mitigation measures

This section should include all measures that have been incorporated into the project design to reduce or to eliminate significant potential environmental impacts during all phases of the project

1. A description of the measures to be taken to prevent, reduce, remedy or compensate harmful impacts of the project, e.g.:
 - i) site planning
 - ii) technical measures such as process selection, recycling/reuse of waste material and waste utilization processes
 - iii) aesthetic and ecological measures such as mounding, design and taking advantage of topography, landscaping, tree planting
2. Compensation for harmful impacts such as compensation for loss of use (grazing land, access, etc.) and subsidizing community projects.
3. Details of possible contingencies, their impacts on the environment and mitigating measures including the maintenance programme.
4. Details of safety and emergency response procedures and contingency plans.
5. Risk assessment and management.
6. Proposals for an environmental monitoring programme.
7. Site restoration after use.

Conclusion and additional information

This section include:

- conclusion,
- definitions and abbreviations,
- information sources, consultations, public participation, and
- references.

**United Arab Emirates:
Status of cage aquaculture development**

by

Mustafa Al-Shaer and Thomas Cherian
Marine Resources Research Centre
Ministry of Environment and Water

EXECUTIVE SUMMARY

Commercial cage aquaculture commenced in 1999 and it is expected that an increasing number of fishermen and private entrepreneurs will be lured into this business area in the near future. Various incentive schemes such as provision of subsidized gear, free supply of fingerlings and training for local fishermen are under consideration by the Ministry of Environment and Water. The deteriorating of the marine environment is considered one of the major constraints to the development of the sector while suitable areas for cage aquaculture are in strong competition with other developmental projects, e.g. resorts, housing and commercial buildings).

BRIEF HISTORY OF MARINE CAGE CULTURE

The history of marine cage aquaculture in the United Arab Emirates (UAE) dates back to 1999 when about 20 circular cages were installed in the coastal waters off the coast of Ras Al-Khaimah by a private company (ASMAK) which then moved them to Dibba on the east coast in 2001. The first finfish species cultured were the Sobaity bream (*Sparidentex hasta*), the gilthead seabream (*Sparus aurata*), and the European seabass (*Dicentrarchus labrax*). Eventually, local fishermen also started to keep in locally made cages located in the lagoon area of Umm Al-Quwain to stock commercially important juvenile bycatch fish. This practice was initiated in order to abide by the Federal Law No. 23 of 1999 regarding the exploitation, protection and development of living aquatic resources in the waters of the UAE. Along the west coast, many of such cages are used mainly for stocking grouper juveniles (Hamoor).

THE CURRENT SITUATION

The coastline – The United Arab Emirates has a coastline of about 700 kilometres on the west and east coasts facing the Arabian Gulf and Gulf of Oman in addition to the coastline surrounding the numerous islands belonging to the country. The country has a continental shelf area of approximately 51 400 km². The shelf area is wider and shallow on the western coast and relatively narrow on the east coast. Wind is predominantly from Northwest.

Farmed species – The endemic Sobaity seabream (*Sparidentex hasta*) and the introduced gilthead seabream (*Sparus aurata*) are the main species selected for commercial cage culture. The orange-spotted grouper, *Epinephelus coioides*, is also reared to some extent in floating cages.

Seed and feed supply – Hatchery-produced juveniles of Sobaity and gilthead seabream are air lifted from exporting countries. More recently Sobaity juveniles have been produced at the Marine Resources Research Centre, Umm Al-Quwain, and supplied to farmers operating cages off the Dibba coast. With regards to the orange-spotted grouper all seed material (Juveniles) are wild-caught.

Type and size of cages – The cages used for commercial farming of Sobaity seabream and the gilthead seabream are the circular type with a diameter of about 20 m (60 m circumference) and a net depth ranging between 8–13 m. These structures are imported from Norway and installed about one mile off

the coast. The traditional cages used by fishermen measure 2.5x2.5x2 m in size and are constructed locally.

Number of existing farms and cages – Presently there is only one commercially cage culture project which operates 60 functional cages. There is no official record regarding the number of traditional cages used by the fishermen. Furthermore, there are a series of protected area around the Fujairah region on the east coast as well as other locations along the west coast where fenced aquaculture is being carried out.

Past and current production – The production details of Sobaity and gilthead seabreams for 2005 and 2006 are given in Table 1.

Table 1. Production values from cage aquaculture for 2005 and 2006 in tonnes

Year	Species	Production
2005	Sobaity seabream (<i>Sparidentex hasta</i>)	37.30
	Gilthead seabream (<i>Sparus aurata</i>)	785.83
2006	Sobaity seabream	119.59
	Gilthead seabream	767.38

CURRENT CONSTRAINTS AND OPPORTUNITIES

Cage aquaculture has significant developmental potential and can partly alleviate the increasing national demand for marine fish and fish products. This aquaculture sub-sector needs special attention and incentives from the government in order to ensure a significant raise in production outputs. The deteriorating marine environment is considered to be one of the major constraints hindering the development of this industry. Furthermore, suitable areas for cage aqua culture are becoming limited due to space competition with other developmental projects along the coast of the country.

INSTITUTIONAL REQUIREMENTS FOR ESTABLISHING AND OPERATING CAGE FARM

Site selection – Site selection is an important technical aspect in cage aquaculture culture which may be responsible for the future viability of the operation. Cages should be placed in areas where seawater conditions are optimum, have a suitable depth, have an acceptable tidal flow and tidal range, be sheltered from intense wind and wave action and away from industries discharges and other pollution sources. The water depth should be adequate to keep the nets off the bottom and to allow adequate water exchange and flushing beneath the cages. Good water exchange is important to replenish oxygen required by the fish.

Farm licensing – According to the Federal Law No. 23 (1999), Articles 8 to 12, in order to obtain a fishing licence all fishing boats, gear and equipment used must be of the approved type and centrally registered. This regulation is also applicable to vessels used in cage farming operations. However, to date no specific law is in force for licensing aquaculture cage.

Environmental impact assessment (EIA) – The principal wastes from fish farm cages include uneaten feed, faecal material, and chemicals and therapeutics residues, if used. Approximately 70–80 percent of the feed nutrients are released back to the environment enriching the surrounding waters particularly if the surrounding currents are weak. This may have an effect on the planktonic activity as nutrient rich waters may lead to algal blooms. Furthermore sediment accumulation may also deteriorate the water quality and have negative effects on benthic organisms. The authorities therefore

do recognise the importance of undertaking regular environmental monitoring programme although currently no specific laws regulates such activities or demand specific actions to the fish farmers.

INSTITUTIONAL DEVELOPMENT POLICY

National plans and targets – The national fisheries policy supports all systems of aquaculture provided they are environmentally friendly and do not negatively interact with the ecological balance of the marine environment.

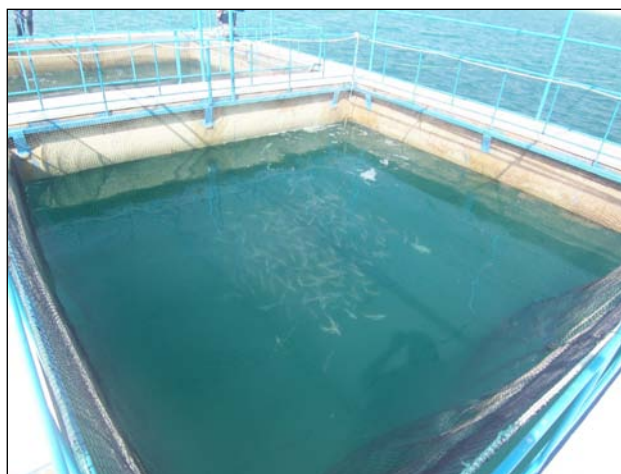
Subsidies and financing policies – The Government has adopted various schemes to promote fisheries in the country mainly by providing subsidized crafts and gear, free service of marine engines, etc. As a result of the declining capture landings and increasing production costs the authorities expect that in the near future an increasing number of fishermen will shift to aquaculture as well as attract new entrepreneurs. Various schemes such as providing subsidized gears, free supply of fingerlings and training for local fishermen are currently under the consideration by the Ministry of Environment and Water.

Production for domestic markets and exports – At present the main production from aquaculture derives from farming the exotic gilthead seabream. Almost the entire production is exported to European Union countries. However, as the population grows and sectors such as tourism expand, there will be an increasing demand for fish particularly for those commercially important endemic species. The future development of cage aquaculture in the United Arab Emirates may lay on the ability of the sector to produce significant quantities of endemic finfish species highly demanded in the local market.

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Photos illustrating cage aquaculture in the United Arab Emirates. *Top row* – artisanal and traditional floating net cages for confining wild-caught juveniles of commercially important finfish species (mainly the orange-spotted grouper - *Epinephelus coioides*); *Middle row* – Commercial cage aquaculture using imported circular and flexible structures off the coast of Dibba; and *Bottom row* – Cage aquaculture using a fixed cage culture structure.



Regulation of Norwegian net-cage fish farming

by

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INTRODUCTION

Over the past 40 years Norway's fish farming industry has developed from small-scale pioneering net-cage operations to the large-scale modern facilities of today. Parallel to the growth of the industry there has been a development in legislation and regulations covering all aspects of production, as well as management plans and monitoring for control of diseases and environmental problems. During the growth of the industry a number of disease problems and environmental effects were encountered. Some of these have been minimized or resolved while others have grown in importance and new ones have emerged.

Marine fish farming started in Norway in the 1970s and at first, the number of farms was small and annual production was only a few thousand tonnes. Moist feed was used and farming was extensive, with few fish in each cage. In 1973 there were approximately 300 farms and the first provisional Aquaculture Act was drawn up, and in 1981 the first permanent Aquaculture Act was passed.

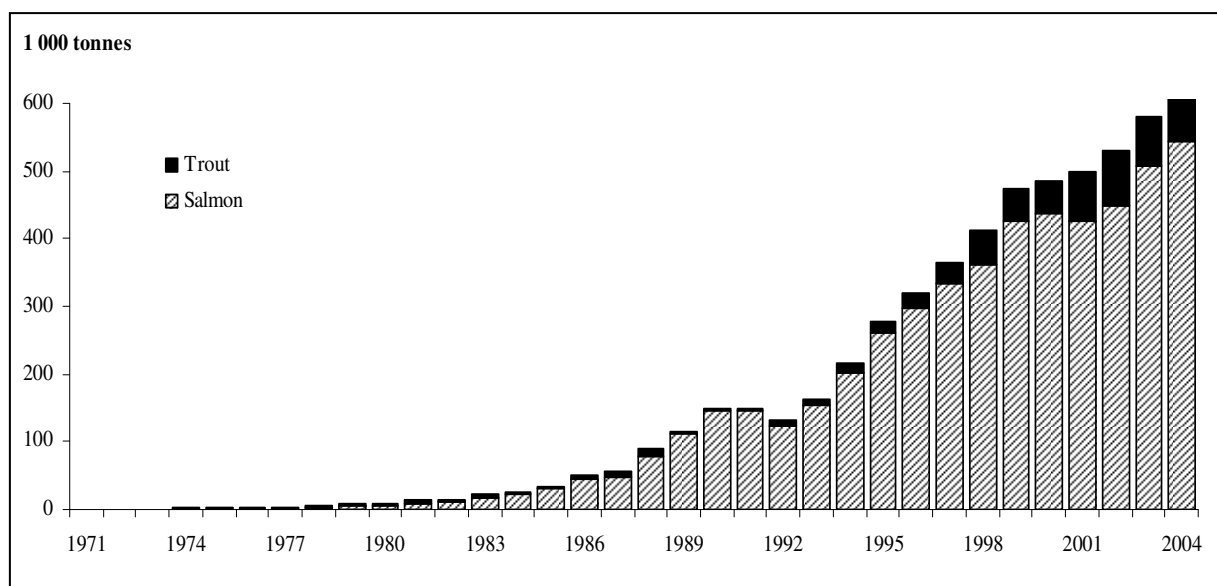


Figure 1. Production of salmon and rainbow trout from 1971 to 2004 in tonnes (Directorate of Fisheries)

During the 1980s, production rose substantially (Figure 1). Proper fish-feed pellets based on improved feed formulas were developed, improving fish growth rates and reducing waste feed. However, infectious diseases and the environmental impact of fish farming began to be a problem. Fish farms were located in shallow and protected areas with low current velocities, and the organic waste from the farms had serious effects on the seabed. Infectious diseases hampered the sector and large quantities of antibacterial agents were used in an attempt to solve the problem. Furthermore, conflicts with other users of the coastal zone were becoming more prominent. This eventually led to the development of new legislation and regulations. Vaccines were developed and hygiene regulations were implemented, together with a change in site selection criteria in favour of more exposed sites. Environmental objectives were drawn up and environmental monitoring programmes were developed. There was also a change in the industry from many hundreds of individual licenced fish farming companies in the 1980s to the current situation of around 150 companies with up to 20 licences each.

The Atlantic salmon (*Salmo salar*) and the rainbow trout (*Oncorhynchus mykiss*) have dominated the production from the beginning, but the Atlantic cod (*Gadus morhua*), the Atlantic halibut (*Hippoglossus hippoglossus*) and the blue mussels (*Mytilus edulis*) are also produced as well as small quantities of other marine fish species and shellfish. From the small beginnings in the 1970s, production of salmon and trout has grown to 580 000 tonnes in 2007. Approximately 50 000 tonnes of other marine fish species and shellfish were produced in 2007, including cod and mussels.

Norway is particularly suitable for cultivation of cold-water species in net-cages. The country is situated in the northern part of the Scandinavian Peninsula between the 58th and 71st northern parallel. Norway is about 3 000 kilometres long with a total area of approximately 324 000 square kilometres and a population of 4.7 million. The coastline is approximately 25 000 kilometres long, when the mainland plus the many fjords, islands, and minor indentations are included. There are approximately 50 000 islands along the coast of which just 2 000 are inhabited. The length of the entire coastline including islands is about 60 000 kilometres. In spite of its location in the far north, the entire coast is free of ice during winter because of warm Atlantic water which flows northward along the entire western and northern coast.

Mean water temperatures along the coast range from 2–4 °C during the winter to 12–14 °C in the summer in the upper layers. On the coast, the mean salinity ranges between 28 ppt and 34 ppt, but in the fjords the upper layers may consist of freshwater flowing in from the many rivers, especially in the spring when the snow melts in the mountains. The fjords on the western coast are sill fjords with a threshold at the mouth that is often much shallower than the fjord basin within. Fjords may reach depths of several hundred metres and some may penetrate up to 200 kilometres inland. In northern Norway the fjords are open and shallower. The current regime along the coast is driven by the Atlantic current, waters from the Baltic Sea and the North Sea, freshwater from the coast and wind. In the fjords the current regime can vary with the season, water-exchange incidents and wind conditions.

More than 1 800 fish farms sites are located in the fjords and archipelagos along the western and northern coastline where they are protected from the open sea but where the current regime is adequate for fish production. In contrast to the shallow and protected areas of the early years the sites in use today are often located in exposed areas and may have depths up to several hundred metres.

ESTABLISHING A NET-CAGE FARM FACILITY

Norwegian fish farming is controlled by laws and regulations both with regard to the application for a licence and site and later during the operation of the farm.

Licence

It is illegal to farm fish or shellfish in Norway without a licence. The licensing system for salmon and rainbow trout is slightly different from those for other species since the authorities try to regulate the growth of the industry by keeping the number of licences (and thereby the potential production) under control. There are currently 921 licences for salmon and trout farming that have been assigned by the Ministry of Fisheries (now the Ministry of Fisheries and Coastal Affairs) in licensing rounds over the past 30 years. The Ministry decides the total numbers of licences to be allocated and how many each region will receive, and this is partly based on considerations of regional development. The licences used to be free, but they are often sold on for large sums, and since 2002 the authorities have charged around USD 1 million per licence for salmon and rainbow trout. Although licences can be bought and sold, they can only be used within the region to which they have been allocated. Licences for other species are not subject to overall production regulation, since the production is still small, and these licences are still free.

Licences include a set of rights and obligations; they are issued for a given species and for a maximum biomass, for salmon and rainbow trout they permit a maximum standing biomass of 780 tonnes.

The application

The application for an aquaculture licence and a site to farm is integrated into one application form which must be completed as described in “Guidelines for completion of application form for aquaculture permit for floating or shore-based facilities” (Anon., 2008). The applicant must provide both production-related and site-related information and the following must be included:

1. Planned production
2. Expected feed consumption
3. Contingency plan describing actions in the event of an outbreak of infectious disease on the farm
4. Chart of the area (1:50 000), site map (1:5 000) and farm map (1:1 000)
5. Exact position of the farm (geographical coordinates)
6. Current measurements at the site
7. Description of the seabed at the site
8. Map of bottom topography at the site
9. Salinity throughout the water column
10. Depth of thresholds in threshold fjords
11. Distance to sea traffic, ferries and other shipping activities, underwater cables and pipelines

Two of the points (6 and 7) entail measurements and must be performed by qualified consultants.

Current measurements must be made at the site over a four-week period at three different depths: at the surface, midway between surface and seabed, and the seabed. The surface current measurement provides information about the water exchange in the net cages; the current between surface and seabed is the dispersion current which is important for dispersing waste particles away from the farm, and the seabed current is important for the ability of organisms living in the seabed to break down the organic waste from the farm.

A description of the seabed at the potential site must be provided. This is done by a study of the natural condition of the seabed and the fauna according to a Norwegian Standard (NS9410) (Norwegian Standards Association, 2000). The standard describes what to measure and how, and it includes a categorization of the seabed on the basis of the results. This provides the authorities with an assessment of the seabed conditions which can be used to make an informed decision on the ability of the site to accommodate effluents from the fish farm.

If the applicant applies for production of more than 3 600 tonnes on a site, more extensive investigations regarding the environmental impact must be performed.

The application process

The Aquaculture Act (Anon., 2005) states that production must not lead to a risk of spreading diseases among fish and shellfish or cause pollution or have a distinctly unfortunate location in relation to the environment, lawful traffic or other uses of the area. There must be no likelihood of damage to the ecosystem where production will take place and all due precautions must be taken. Before a licence is granted, land-use interests must be considered, as well as alternative use of the area for other forms of aquaculture, other uses of the area and conservation interests.

The application process is illustrated in Figure 2 and described in “Guidelines for completion of application form for aquaculture permit for floating or shore-based facilities” (Anon., 2008; in Norwegian). The application is delivered to the Directorate of Fisheries’ regional office in the region concerned. The regional office coordinates the processing of the application and forwards it to other relevant authorities. This procedure, whereby the application is delivered to one office, simplifies the process for the applicant and improves the overall evaluation by involving all the relevant authorities under a single coordinator. The same procedure is used when an applicant applies for a new site for an existing fish farm or if the applicant wishes to considerably increase the size of a fish farm at an existing site.

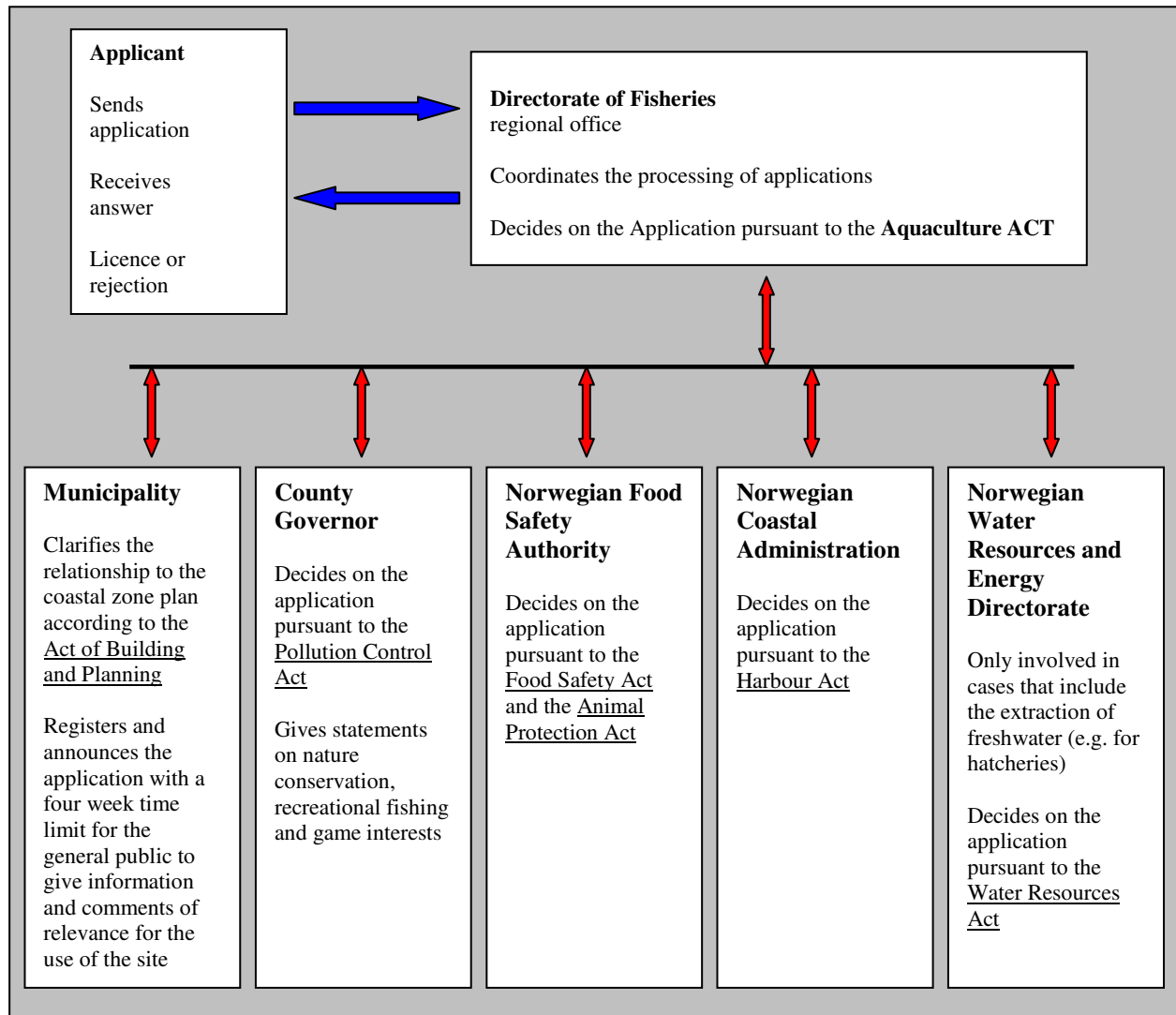


Figure 2. Flow chart of the application process for an aquaculture licence (Directorate of Fisheries)

Once an application has been registered, the Directorate of Fisheries regional office forwards it to the municipality. After being processed by the municipal authorities the application is returned to the Directorate of Fisheries, which then forwards the application, including any remarks from the municipality, to the County Governor's Environmental Department, the Food Safety Authority local office and the Coastal Administration regional office.

The different authorities are bound by a number of Acts of Parliament when they evaluate and assess the application, and these are under the jurisdiction of the Ministry of Fisheries and Coastal Affairs, the Ministry of the Environment and the Ministry of Local Government and Regional Development, respectively.

Eight different acts are considered during the application process by the five authorities:

The Aquaculture Act (Anon., 2005) – *The Directorate of Fisheries*

The Building and Planning Act (Anon., 1985) – *The municipality*

The Pollution Control Act (Anon., 1981) – *The County Governor's Environmental Department*

The Nature Conservation Act (Anon., 1970) – *The County Governor's Environmental Department*

The Fish Diseases Act (Anon., 2003) – *The Food Safety Authority*

The Food Safety Act (Anon., 2003) – *The Food Safety Authority*

The Animal Protection Act (Anon., 1974) – *The Food Safety Authority*

The Harbour Act (Anon., 1984) – *The Coastal Administration*

Environmental impact assessments

The International Association for Impact Assessment (IAIA) defines an environmental impact assessment (EIA) as “the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made”. The purpose of the assessment is to ensure that decision-makers consider the potential environmental impacts before deciding whether or not to proceed with the project. However, the EIA is merely a first step and must be followed by policies or laws which ensure that the conclusions of the assessment are followed. An environmental impact assessment is of limited value if it is not followed by monitoring.

In Norway, the potential consequences of the fish farms for the environment are determined by the authorities. Based on the information provided by the applicant the decision-makers identify and predict the likely environmental, social and other related effects of the proposal. The aim is to facilitate sustainable development.

The municipality

The municipality sorts out user conflicts and considers the application with regard to the various activities in the coastal zone, according to the Building and Planning Act. A four-week time limit is given for the general public to comment on or complain about the proposed fish farming activity.

Many municipalities have drawn up a coastal plan that allocates space for activities such as aquaculture, recreation, fishing, navigation and naval defence and combinations of these. The proposed plan undergoes a public hearing process whereby, among others, governmental bodies at the county level, such as the County Governor and the veterinary authority have their say. The municipalities incorporate any remarks and approve the plan. Exemptions (dispensations) from the plan can be forwarded and must be approved by the County Governor’s Environmental Department. According to this procedure, no fish farming site can be approved if it violates the municipal coastal plan. Many coastal municipalities have developed area plans for their coastal areas. There is no requirement that marine biological surveys should be performed before an area for aquaculture is allocated. However, according to the Pollution Control Act, such surveys must be carried out before a new site can be approved.

In addition to the environmental assessment at county level, there is an indirect environmental evaluation at municipal level. This clarifies the relationship to the coastal zone plan according to the Building and Planning Act (land use, sorting out user conflicts). Environmental issues are considered in the course of the planning processes.

The County Governor’s Environmental Department

The County Governor’s Environmental Department considers the application with regard to pollution, sensitive habitats, biological diversity, nature conservation, recreational fishing and other environmental related interests. An important part of the evaluation process of the application is environmental considerations. The environmental concerns are divided into pollution and other issues.

A licence incorporates a permit to contaminate. This pollution permit is given by the local branch of the Ministry of the Environment (the County Governor’s Environmental Department) and is based on the Pollution Control Act, which this Ministry administers.

The pollution permit is based on an evaluation of the discharge of effluents from the fish farm and its potential effects on the environment at the site and the surrounding area. The effluents considered are organic waste and nutrients, surplus feed, fish faeces and toxic chemicals. These parameters are assessed together with other data from the site, such as current conditions at various depths, site topography, depths, and wave exposure. The potential influx to the farm site of sewage or industrial out-lets, and effluents from agriculture, are also considered.

After a comprehensive analysis a pollution permit is issued. This permit sets out a number of restrictions on the production of the farm. The most important are a limitation on total biomass, fallowing practices that must be followed, monitoring regime for the effects of discharges, instructions for handling waste (both organic and other), removal and treatment of dead fish and handling of hazardous chemicals. The permit provides instructions regarding what must be monitored and at what frequency, in order to ensure environmentally sound usage of the site.

In addition to pollution, a fish farm can affect the environment in other ways. An assessment is made of the impact of the farm on nature conservation issues such as closeness to sensitive species and biotopes, seabird sanctuaries and related issues. The distance between the farm and recreational sites for bathing, leisure boat traffic and touring is also considered, and migrating routes for wildlife must be taken into account. Such issues are usually dealt with by the County Governor's Environmental Department, as the professional environment agency at the county level with jurisdiction concerning the relevant Acts of Parliament. In the case of fish farming, however, the Aquaculture Act requires the assessments of these issues to be carried out by the Ministry of Fisheries at provincial level, but the County Governor's Environmental Department provides advice on these issues to the fisheries authorities.

Atlantic salmon are indigenous to Norway and according to the Convention for the Conservation of Salmon in the North Atlantic Ocean (NASCO) of 1982 it must be protected. Salmon fish farming affects the wild populations mainly through escaped farmed fish which may interbreed with the wild salmon and thereby genetically change them, but may also infect the wild fish with parasites, mainly sea-lice. This is currently regarded as the most severe adverse effect of the salmon farming industry on the marine environment in Norway. A great deal of effort is therefore being put into measures to give the wild salmon and sea-trout biotopes better protection.

The food safety authority

Problems of disease are unavoidable when large numbers of animals are held in confined spaces but it is vital to prevent or contain them. The Food Safety Authority considers whether the application is in accordance with legislation on fish diseases and fish welfare. It looks specifically into the aspect of prevention of diseases and the potential transmission of harmful germs. An assessment of the fish health conditions in the region is carried out and the distances between sites, particularly the distance between processing facilities such as slaughter houses and net cages, are considered. For slaughter houses there are strict rules for the processing and the discharge of effluents. Specific consideration is given to protect hatcheries and broodstock facilities from contamination. There are also specific rules for the distance between hatcheries and fish farms, and between slaughtering facilities and fish farms; both must be at least five kilometres.

The Food Safety Authority may also require a fallowing regime plan to be implemented at the site. If an outbreak of a serious disease occurs this authority will issue specific instructions for how to slaughter and treat the dead fish and any equipment used.

Other authorities

The Coastal Administration ensures that the planned farm will not be in conflict with shipping lanes and pipelines.

In cases where the use of freshwater is involved, such as salmon hatcheries, the Water Resources and Energy Directorate is involved, and it evaluates the application with regard to the Water Resources Act (Anon., 2000).

The Directorate of Fisheries

Each of the authorities reports to the Directorate of Fisheries regional office. The Directorate then makes an overall assessment of the application, and looks into specific concerns from its own departments, such as any influence of the farm on fishing and breeding grounds, etc. If none of the authorities reject the application it will be considered with regard to the Aquaculture Act. The applicant will then receive either a licence or a rejection notice. In the event of the latter the applicant may appeal to a higher authority; the Fisheries Directorate, the Pollution Control Authority, the Food Safety Authority regional office or the National Coastal Administration.

Site selection

Identifying a good site is a key element in sustainable fish farming, and the natural conditions of a site are crucial. The application process is intended to facilitate good site selection and preferably identify a site that can be used on a long-term basis.

The natural conditions of a good site are linked to the current regime. An adequate current in the surface water will ensure that the farmed fish receive sufficient oxygen and that excretion products are flushed away. The wider water column current disperses the faeces from the fish together with uneaten feed, and decreases the risk of accumulation of waste products on the seabed under the farm. The current at the seabed provides oxygen for decomposition of accumulated organic waste and may occasionally cause resuspension of sediment and waste. Deeper sites are preferred to more shallow ones since they help to ensure a wider dispersion of the organic waste, but even at sites over 200 m deep accumulation of organic waste has been found.

Site selection is also an important factor in diseases prevention. Good sites ensure that the fish have good quality water and sufficient oxygen, and that they remain in good condition, which makes them less susceptible to disease.

Models can be a useful tool in identifying adequate fish farm sites. A model has been developed for Norwegian fish farming that estimates the maximum production of fish that a site can accommodate without exceeding threshold levels for permissible impact (Stigebrandt *et al.*, 2004). This model can be linked to another model that simulates the environmental quality of fjords (Aure and Stigebrandt, 1990). Such models may improve initial site selection and provide a simulation of the potential impact in larger water areas.

In Norway, the minimum distance between sites is normally 2–3 kilometres, depending on local conditions. For the time being, therefore, there are few instances where the organic impacts of two sites overlap. However, clusters of fish farms occur in many other countries and in many such cases a site cannot be regarded as an individual entity. In such cases site selection must be seen in relation to the overall level of fish farming activity in the area.

Environmental objectives

Environmental impacts are unavoidable in fish farming and it is vital to find ways to minimize them. To do so, the impacts must be identified and their severity assessed. The authorities must decide which impacts are the most important and how they can be controlled, and drawing up environmental objectives is a useful tool. The first environmental objectives for Norwegian aquaculture were developed in 1993 (Anon., 1993). Defining the objectives was a joint project between the authorities concerned with aquaculture in Norway at the time: the Directorate for Nature Management, the

Directorate of Fisheries, the Norwegian Pollution Control Authority, the Norwegian Board of Health, the Norwegian Medicines Control Authority, and the Ministry of Agriculture Department of Veterinary Services. The report outlined the political objectives that the Government and Parliament had decided upon, and these served as overriding objectives. The report also described the international conventions and treaties that Norway had signed and that must be followed.

The environmental objectives for Norwegian aquaculture were divided into various problem areas with a description of each, and both short-term result goals and long-term environmental objectives for the results for each type of impact were set out. In Norway, the most important environmental impact areas were the following: escaped farmed fish, diseases, medicines, chemicals and organic waste and nutrients. The report was followed by annual reports which described the current situation and whether the goals had been achieved (e.g. Directorate for Nature Management, 2000), and in 1997 the environmental objectives were audited (Directorate for Nature Management, 1997). The objectives have not been audited since then and the last annual report was made in 2001. However, there are plans to renew the environmental objectives and revive the annual report system.

RUNNING A NET CAGE FISH FARM FACILITY

Internal control

During the operation of the farm there are a number of regulations and standards that must be complied with. The licence requires the farmer to record the operational activities of the farm on a monthly basis. These records are compiled annually into a report that is submitted to the Directorate of Fisheries. The problem areas identified by the environmental objectives must be minimized and monitored.

The following must be reported:

- stocking (number, species, origin, stocking time and weight)
- fish density (limited due to fish health and fish welfare considerations)
- depth of net cages
- consumption of feed
- number of escaped fish
- number and condition of slaughtered fish
- number of sea lice on the farmed fish
- use of medicinal products (type and name, quantity used and treatment period)
- use of chemicals (type and name, quantity used and consumption period)
- use of net impregnating agents
- catches made during fishing for monitoring or recovery purposes (escapes)

Escape of farmed fish

In order to ensure that farms can withstand adverse weather conditions, all farms must comply with a technical standard on farm construction (Anon., 2003). This reduces the risk of the farm being damaged or wrecked and of fish escaping. Escapes of salmon from the farms are regarded as a serious problem, since the farmed fish may interact genetically with wild salmon. In the case of an escape event or suspected escape the Directorate of Fisheries must be notified and recapture of escaped fish within a radius of 500 metres from the farm is initiated as required by the Aquaculture Operation Regulations (Anon., 2004).

The standard contains requirements for the physical design of the installation and the associated documentation. This includes calculation and design rules, as well as installation, operating and maintenance requirements. There are requirements for the physical design of all the main components in an installation, and regarding how the installation should be operated in order to prevent escape. All components of new installations must be certified by an accredited body, and existing installations must be issued with a certificate.

Disease and parasites

Diseases are an inescapable factor in fish farming and controlling them takes high priority. The Operation and Diseases Regulations must be observed, and contingency plans must be in place. Many of the major infectious diseases encountered over the years have been combated by vaccination and improved hygiene. This has resulted in very little use of antibacterial agents in current Norwegian fish farming. However, new diseases emerge and can not be prevented by vaccines; moreover, it takes time to develop new vaccines. Rigorous hygiene procedures must therefore be observed and any disease outbreak must be reported to the authorities.

The farms must comply with principles for good fish health management. The primary focus is on disease prevention and a number of actions are taken. The use of fresh or frozen fish for feed is prohibited, since this is a perfect route for the transmission of diseases. Only fish of known origin may be stocked, and stressing the fish must be avoided. The different year-classes must be kept at different sites and fallowing of sites between production cycles is required.

Sea lice infestations are a major problem in Norwegian salmon farming. The local authorities have the jurisdiction to gather monthly reports, make unannounced checks on farms and demand delousing if lice levels exceed the targets stated in the National Action Plan for Sea Lice. At all fish farms sea lice must be counted at least every second week when the water temperature exceeds 4 °C, and the results reported to the Norwegian Food Safety Authority. If the number of lice per fish exceeds the threshold limits the fish farmer is required to delouse at the farm (Anon., 2000). In many areas, the authorities require all the fish farms in the area to synchronize their delousing.

Medicines and chemicals

All medicines must be prescribed by a veterinarian and consumption is registered by the Norwegian Medicines Control Authority and the Directorate of Fisheries. The usage of antibacterial agents is currently low, but sea lice medicines both as bath treatments and in-feed medicines are in use.

The most frequently used chemicals in Norwegian fish farming are antifouling compounds for the cage nets. The most usual is copper, although this compound is intended to be phased out and its use should be significantly reduced before 2010 in accordance with The Hague Declaration of March 1990 (Anon., 1990). However, it has proven difficult to find a substitute, and there are still large amounts of copper in use.

There are no mandatory monitoring requirements for medicines or chemicals in the environment, but the environmental authorities have the right to require monitoring under the terms of the Pollution Control Act (Anon., 1981).

Environmental impact of organic waste and nutrients

The flux of organic waste (i.e. waste feed and fish faeces) and nutrients (dissolved nitrogen and phosphorous compounds excreted from the fish) is an inescapable consequence of fish farming. The amount of effluents depends on the production but also on how well the farm is run, especially with regard to the amounts of waste feed. The effects of the effluents vary with the site and are one of the main reasons that site selection is so crucial. The current velocity in the upper layers of the water is

vital to the removal of excretion products from the fish. These are nutrients, and they may facilitate increased algae growth in the surrounding area.

According to the Environmental Objectives of Norwegian aquaculture, organic waste from fish farms must not result in unacceptable effects on the environment, either locally or regionally (Directorate for Nature Management, 1997). Because fish farm sites vary greatly in terms of hydrographical conditions and depths, the amount of organic waste that settles on the seabed also varies widely. Furthermore, the size and the management of the fish farm may influence sedimentation rates. The impact, such as changes in seabed chemistry and in the benthic fauna community, therefore also varies widely between sites.

A fish farm may have an impact on the wider area around the farm, and there are often different impact zones. The local impact zone, which is the immediate vicinity of the farm, is where the most severe impact is found and where most of the organic waste tends to settle. Anything in this zone is at high risk of being impacted by the farm. Smaller particles will travel further away from the farm and have a lesser impact, but may be a threat to sensitive species or habitats.

Overloading of sites and accumulation of organic material in the form of waste feed pellets and faeces can, besides the effects on the environment, be a cause of stress, poor growth and disease in the farmed fish, with the associated spread of infectious agents and need for medication. Organic material can therefore play a role in several types of environmental impact, even if the effect is greatest on the sediment under the cages.

Environmental monitoring

Monitoring the seabed under fish farms is mandatory in Norway as established in the Aquaculture Operation Regulations (Anon., 2004), and monitoring of the larger area may be required by the County Governors' environmental departments. Monitoring is performed in accordance with Norwegian Standard NS9410 (Norwegian Standards Association, 2000. *Environmental monitoring of marine fish farms NS-9410*. Available from firmapost@pronorm.no) and the responsible authorities are the Fisheries Directory and the County Governors' environmental departments. The standard describes methods for measuring impacts from marine fish farms on the seabed, and provides detailed procedures for how environmental impacts from individual fish farm sites are to be monitored. Environmental Quality Standards (EQS) are incorporated in the standard for fish farm sites, while for the wider area the EQS used are general threshold values for the entire Norwegian coast (Molvær *et al.*, 1997).

The monitoring standard NS-9410 focuses on methods to determine the condition of the seabed at and around fish farms. Traditionally, monitoring of seabed impact at fish farm sites has consisted of fauna community analysis. This type of monitoring is maintained in NS-9410, but mainly in the larger area, and at the site less time-demanding and less expensive surveys are being used. Threshold values for environmental impact are set such that fish farm sites may be in use over a long period of time, and aim to ensure that the farmed fish enjoy favourable living conditions as well as to prevent unacceptable impact on the surrounding area. The EQS sets a limit for maximum permissible impact and makes it possible to distinguish between different impact levels. The condition of the seabed is divided into four categories, ranging from no impact to unacceptable impact. How often the monitoring is performed depends on the impact on the site; if the impact is small, monitoring is performed seldom and if it is large the monitoring is frequent. If the impact is unacceptable, the fish farms used to move to another site, today, however, other mitigation methods, such as reducing production or changing the position of the farm within the site, are used. This is in accordance with the principle that fish farm sites should be used over a long period of time.

The NS-9410 is based on the monitoring programme and the EQS of a management system called MOM (Modelling – On growing fish farms – Monitoring) that combines modelling of potential impact with monitoring benthic impact (Ervik *et al.*, 1997; Hansen *et al.*, 2001). The monitoring programme

includes three types of surveys (A, B and C investigations). The A- and B-investigations survey the potential and actual impacts on the sediment under and in the immediate vicinity of the fish farm. The C-investigation aims to obtain a picture of the impact on the recipient as a whole. The model may be used during the initial stages of identifying a suitable site or if the fish farmer wishes to increase production at an existing site.

The authorities may also order additional monitoring to that already required under statutory monitoring requirements, before the farm begins operating, during operation and after the site has been abandoned.

CONCLUDING REMARKS

The Norwegian fish farming regulatory system has grown out of the development of the fish farming industry. The legislation and regulations often lagged behind the rapid growth of the industry, especially in the early days, and was not put into effect until severe problems had been encountered. However, it is in the interest of both the authorities and the industry to have strict regulations, and for the long-term prosperity of the industry it is crucial. Good regulatory systems ensure that both the large-scale and long-term consequences are considered and dealt with.

Norway is particularly suitable for marine fish farming, since natural conditions, with a long coastline with sheltered sites and generally good water quality, are favourable. However, the industry has been hampered by both diseases and environmental problems over the years. Choosing the right site has turned out to be crucial. Site selection is mainly based on natural conditions and the current in the water column is an important parameter of good water quality for the farmed fish and to avoid impact on the seabed. The distance between sites of different year classes and the distance to other fish farms are also important with regard to transfer of diseases.

Norway is a major fishing nation, and combining fisheries and fish farming in the coastal zone is a constant challenge. Apart from fishing grounds there are spawning areas along the coast and in the fjords that must be protected. The coast also harbours various special habitats such as cold water coral reefs and there are other valuable underwater areas along the coast which must be protected.

Norway's location on the verge of three major seas means that there are no impacts or disputes with other countries. However, when many countries share a water body it may be useful to consider common regulations and monitoring in a number of areas.

Sustainability and integration with other coastal activities are fundamental to the viability of an aquaculture industry and a regulatory system that can ensure environmentally acceptable operation in the coastal zone is therefore needed. In Norway, a system is under development that will cover both the planning and the operational phases of aquaculture and ensure that available space for aquaculture is efficiently used and that the best sites are selected. Information about topography and hydrography as well as an overview of different uses and environmental status will be combined with simulation models to site aquaculture activities and to adapt the environmental impact of aquaculture to local and regional conditions. Monitoring will be an important element and will ensure that the environmental capacity is not exceeded.

ACKNOWLEDGEMENTS

Comments and corrections were provided by Anne-Karin Natås from the Directorate of Fisheries.

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Proposed environmental impact assessment format

An environmental and social impact assessment (EIA) is defined as the process of identifying, predicting, evaluating and mitigating the biophysical, social and other relevant effects of development proposals prior to major decisions being taken and commitments made. It is a formal and structured approach for obtaining and evaluating environmental information prior to its use in decision-making in the development process. This information consists, basically, of predictions of how the environment, human health and welfare are expected to change, if any, if a range of alternative actions are implemented, and advice on how best to manage environmental changes if one alternative is selected and implemented. The “environment” includes the biological and physical environment as well as the socio-economic environment.

A net-cage fish farm is such a development proposal or activity that requires an EIA to be performed. An EIA in this case is an analysis or study of the consequences or impacts of fish farm operations on the natural and social environment in its broadest sense. The scope of an EIA varies and should be modified as appropriate to ensure the collection of the information required to state with sufficient certainty/authority whether the impact will be sustainable or not.

Today, EIAs are a legal requirement for major development projects with significant environmental impacts in most industrialized countries and in many developing countries. The benefits of an EIA are many, and include, among other things, improved environmental protection, the long-term lowering of project costs, facilitation of the identification of the investment required for mitigation actions, and improved project acceptance by the general public.

Suggested contents of an EIA study¹:

1. Introduction

The EIA should contain a short description of the site, a description of the planned activities and of the importance of the project.

2. Description of the proposed project

The plan of the proposed project should be shown on the appropriate bathymetric map (scale 1:1 000 or 1:2 500) together with a site plan that shows the location of buildings, land installations and other structures. The description should include:

- a) Details of the construction methods to be adopted (materials used, transport suitability of roads, etc.).
- b) Detailed description of the farming operations proposed at the site (methods, species, initial and future production capacity, expected patterns of stock weight and feed input, etc.).
- c) An estimate of the quality and quantity of waste products produced by the farm's operations, disposal of wastes, mortalities, disease and other treatments.

3. Reasons for selecting the proposed site and technologies

The reasons for selecting the proposed site, including a short description of alternatives that have been considered, should be given.

¹ The above is adapted from the Priority Action Programme/Regional Activity Centre (PAP/RAC), Mediterranean Action Plan.

4. Site description and environment

- a) The physical characterization of the local aquatic environment should include information on the following:
 - i. an onshore topographic and offshore bathymetric map of the site, extending at least 1 kilometre beyond the proposed farming location;
 - ii. details of any existing underwater banks, physical obstruction, etc., which could hinder movements of water masses and their communication with the sea; and
 - iii. description of the shore and bottom type.
- b) Meteorological, hydrographical and hydrological information:
 - i. predominant wind direction, wind velocity and intensity;
 - ii. tidal conditions and the probability of extreme weather conditions;
 - iii. wave conditions and currents; and
 - iv. temperature and oxygen profiles.
- c) Typical water chemistry based on the mean of replicate samples (four) collected at distinct depths (to be specified);
 - i. Salinity, pH, total phosphorus, orthophosphate, total N, ammonia, nitrate, nitrite, suspended solids/turbidity.
- d) Sediment chemistry, based on the mean of replicate grab samples (four) taken below the location of the water samples (see above), which include determinations of:
 - i. types of sediment on the site and its surroundings;
 - ii. redox potential readings; and
 - iii. sediment organic carbon and nitrogen content.
- e) Biological characterization of the local aquatic environment:
 - i. Phytoplankton community including seasonal changes in composition, occurrence of algal blooms, and chlorophyll levels;
 - ii. survey of the benthic community;
 - iii. fishing, breeding and nursery grounds; and
 - iv. mangroves, corals, sea-grass beds, marine mammals, turtle nesting sites, other vulnerable species, sensitive habitats, marine biodiversity.
- f) Present land and sea uses on site and in surroundings:
 - i. location and size of other farming operations in the surroundings;
 - ii. location of nearby settlements;
 - iii. navigation routes, naval/coast guard defence areas;
 - iv. location and extent of tourist activity around the site;
 - v. leisure activities, such as nearby marinas; and
 - vi. proximity of other point sources of nutrients/effluents, including intensity of agriculture, erosion.

5. Identification of potential impacts

An assessment of anticipated or forecasted positive or negative impacts, using accepted standards wherever possible, should be provided, including the following:

- a) Topographic and bathymetric changes and the occurrence of changes during and after construction.
- b) Changes in water circulation due to aquaculture installations.
- c) Sand movements and where increased sand accumulation and coastal erosion is likely to occur.

- d) Hypertrophication and eutrophication – expected response of local biological communities.
- e) Physical accumulation and organic enrichment of aquatic sediments – expected response of local biological communities.
- f) Impact of bottom flora and fauna, the risk of loss of habitat, changes likely to occur (see Point 4e).
- g) Disposal of dead fish.
- h) Aesthetic and visual impacts of buildings or other structures.
- i) Impact on the quality of bathing water and on the cleanliness of beach sand, if any.
- j) Interactions with local fishing communities.
- k) Impact on navigation routes and other activities in the sea (see Point 4f).

6. Measures to reduce or prevent negative impacts

This section should describe all measures – whether technical, legal, social, and economic or other – to prevent, reduce or mitigate the potential negative effects of the proposed aquaculture activity.

7. Monitoring

Measures to be used to monitor the effects on a long-term basis, including data collection and analysis and the enforcement procedures available to ensure implementation of the measures should be given.

8. Bibliography

A list of source materials used or consulted in the preparation of the EIA studies should be given.

**Review on cage aquaculture licensing procedures:
a focus on Chile, Greece, Norway, Spain and the United States of America**

by

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Chapela Pérez, R. 2009. Review on cage aquaculture licensing procedures: a focus on Chile, Greece, Norway, Spain and the United States of America. In FAO/Regional Commission for Fisheries. Report of the Regional Technical Workshop on Sustainable Marine Cage Aquaculture Development. Muscat, Sultanate of Oman, 25–26 January 2009. *FAO Fisheries and Aquaculture Report*. No. 892. Rome, FAO. pp. 95–130.

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INTRODUCTION

According to FAO studies aquaculture is presented as an increasing activity (FAO, 2006). Countries in Africa and Asia are promoting aquaculture as an alternative economic activity in sustainable coastal development. In Europe, aquaculture started with both a high technology and production level in the 1980s. Currently, countries such as Norway, Spain and France have an important level of production and Asiatic countries are leading aquaculture production, with Viet Nam, India, China and Thailand as primary producing countries.

Aquaculture is considered a key contributor, providing increased employment opportunities in coastal areas highly dependent on fisheries, and as a source of nutritionally healthy, affordable protein. This is important when the demand for aquatic food is increasing and crisis in the fisheries sector requires a reduction in fish catches. It is expected that aquaculture will increase the availability of aquatic foods in many countries, not only in those with low levels of fisheries catch but also in those without fisheries tradition.

Most parts of the world are developing some kind of aquaculture. Therefore the definition of a clear legal framework is crucial in order to successfully launch aquaculture activities.

Many countries with a high aquaculture production level started by increasing their production and allowing new facilities to establish without considering legal issues which would help plan and organize the aquaculture activity in a sustainable manner. This was the case in Spain, Greece and Italy. Nowadays it affects Turkey, Morocco and Egypt, among others. These countries point out the lack of legal framework as the main barrier to the sustainable development of aquaculture. Management, planning, organizational and decision making tools are needed. Even capacity building for the staff in charge of aquaculture should be clear before starting the development of the activity.

An overview of the policy and legal experiences of some Mediterranean countries which have established aquaculture regulations will be presented in this report as a benchmark tool. Reference to other Atlantic or Pacific countries, especially Norway, Chile and United States of America will also be made. The report will mainly focus on the overall framework governing marine aquaculture: licence procedures, permit requirements, and the agencies involved.

The information obtained in this study comes principally from the analysis of laws, decrees and aquaculture and fisheries policies existing in the identified countries. The analysis also considers the framework of other Mediterranean countries with specific regulations and with interest for this report.

The quantity and quality of available information varies from country to country. Some of them have legal documents published on Web pages. In the case of the United States of America and Norway, the information was obtained from the Internet. Spanish legal information was gathered from direct sources, consulting fisheries and aquaculture existing laws in regional governments. In the case of Greece, the information was obtained from questionnaires, the Web and from relevant FAO studies. Legal reviews on aquaculture issues have been prepared by FAO and are available for many countries worldwide on legal aquaculture frameworks.¹

OVERVIEW OF POLICY AND LEGAL AQUACULTURE FRAMEWORK

Production increase and pathology control were the main focus of study in aquaculture scientific research in the early stage. The search for new technology was the next step. Currently, when for the

¹ FAO. NALO: Aquaculture Governance. Contains the national aquaculture legislation overview of several countries; Consultation on the application of Article 9 of the FAO Code of Conduct for Responsible Fisheries in the Mediterranean region: Synthesis of the National Reports (TEMP/RER/908/MUL), Rome, 1999; Development of Marine and Inland Aquaculture, Greece, Draft National Aquaculture Plan. Rome, 1987. 18 p. FI:DP/GRE/85/002, FAO, Technical Report.

most part biological and pathogen problems are solved, the next challenge is to put in place a suitable legal framework to promote aquaculture activities.

In order to achieve a regional successful position in aquaculture, both private sector and public administration need to face a significant challenge: to develop policy and a legal framework for aquaculture. In order to succeed, the responsible authorities in fisheries/aquaculture affairs must set up an appropriate framework with rules for licensing, planning, access to land and water, environmental impact assessment, administrative organization and coordination.

As aquaculture investment may be a risky operation, promoters will require information on the regulatory requirements, associated costs and adequate information on the following issues:

- a) Where will aquaculture facilities be permitted?
- b) What are the requirements in order to have a project approved?
- c) What agencies are involved and which of them have the decision-making power?
- d) What are the annual fees they are expected to pay?
- e) What environmental protection measures are required?

Before accepting a concession or authorization that would permit the allocation of rights to exclusive use in land, coastal space or maritime waters, the promoter will also need to be assured that his rights are adequately protected. Only, a clear legal framework can guarantee the investor's legal security.

Furthermore, the lack of continuity in political and economic processes is the main problem which challenges the countries and generates instability. This issue puts off aquaculture investors because many projects are slow-progressing businesses.

This report provides an overview of five case studies of country legislation and addresses more specifically the relevant procedures and legislative authorities to manage and regulate aquaculture in general.

The legal framework for aquaculture: countries with specific rules for cage culture

Many countries have not yet elaborated a specific legal framework for aquaculture development. At present, only countries with a developed aquaculture sector have specific rules regulating the industry. This is the case in Norway, Spain, New Zealand, United States of America, France and Chile. Others have some specific regulations for certain types of aquaculture (i.e. shrimp and shellfish aquaculture). There are cases of countries with no legislation at all, or with minor regulations from the applicable Fisheries Act.

Regulation systems for the use on water or land differ between countries. Systems for aquaculture are also very different and diverse. So it is crucial to design an aquaculture policy framework to discriminate between types of aquaculture systems (inland/offshore aquaculture) and land/water ownership system.

With specific reference to marine cage aquaculture, countries generally have legal frameworks governing coastal area utilization as the coast is part of the public domain and not susceptible of private ownership. Aquaculture licences are granted by the authority with jurisdiction over fisheries and/or aquaculture, while concessions for land or water use in public domain are granted by the state-owned land and water authority, which is a different agency. This issue will be crucial for agencies when coordinating their competence in aquaculture regulation.

This report will analyse specific regulations put into place by some developed countries, in order to identify the most useful tools and common constraints thus, enabling the production of a list of "lessons learned" and guidelines useful for the RECOFI countries.

Aquaculture legal framework in Spain – Licensing overview

Although both inland and marine aquaculture activities are developed in Spain, marine aquaculture is the most important. Spain leads the production of mussels in Europe with more than 3 500 mussel rafts, only in Galicia (northwest of Spain), producing around 212 000 tonnes in 2007. That was the first large-scale commercial aquaculture production in Spain led by family-owned enterprises. The first regulation and aquaculture policy was set up with the aim to tackle the increasing number of applications for a licence when this activity first started.

Marine fish cage culture has developed along the Mediterranean coast and the Canary Islands, where the European seabass and the gilthead seabream (10 040 and 19 855 tonnes in 2007, respectively) are the most common species produced. This activity is governed by different regulation depending on where the activity has developed.

The decentralized form of government in Spain has important consequences for aquaculture in further complicating the legal regime applicable to this activity. There is a decentralisation between a) the autonomous regions (Comunidades Autónomas) with competence and legal authority in aquaculture, and b) the central government where the Ministry of Environment, Rural and Fisheries Affairs only has jurisdiction for designing the general policy of agriculture, fisheries and food. This Ministry has additional functions of coordination and representation through the General Secretariat of the Sea (Secretaría General del Mar). Therefore, aquaculture in Spain is regulated at regional level. Autonomous regions can develop their own aquaculture policy, granting licences, planning the activity, training, organizing farmers, etc. Although, if there are no regulations approved by the autonomous regions, the State Law 23/1984 on marine farming activities will apply.

The central government has the key coordination role through the Sea Harvest Advisory Board (JACUMAR) under the Ministry of Environment, Rural and Fisheries Affairs, and integrated by the General Secretariat of the Sea, the Fisheries Departments of autonomous regions and representatives of various aquaculture organizations. This advisory board is in charge of coordinating the public administrations involved in aquaculture and managing the aquaculture national plans.

Aquaculture licences

Marine aquaculture needs a number of licences from different administrations. The Autonomous regions or regional governments issue the main authorization or concession and give the right to develop an aquaculture activity. However the aquaculture promoter requires another type of licence depending on the site where aquaculture is going to be developed. In the case of marine aquaculture, as the maritime zones are considered public domain or state-owned property, the promoter needs a concession to install the facilities. This concession is issued by the central government (administration in charge of coastal protection: the Ministry of Environment, according to the Coastal Law of 1988). In some cases a third administration could be involved if the aquaculture facility is going to be installed in a harbour area, also considered as public domain, according to the Port Law 27/1992.

So, when the aquaculture facility uses public domain, owned by the state, the granting procedure becomes more complex and needs strong coordination between authorities responsible for aquaculture (regional government) and the authority responsible for managing coastal areas, marine zones, etc. This double concession is a complex and time-consuming procedure that in Spain takes between 18 to 24 months for coastal public domain use and 8 months for harbour public domain use.

Many regional governments tried to reduce the procedures and improve their efficiency by designing coastal zone plan for aquaculture. With planning as a tool for managing aquaculture, the administration defines and sets up maritime and coastal zones designated for aquaculture activities. In the last decade, some of these regional governments started to define these “interested zones for aquaculture” described by Law 23/1985, as “those zones that because of their optimum conditions for aquaculture need official protection”. The European Commission is also concerned about the space

limitations for aquaculture and strongly highlights the importance of technological developments and spatial planning through this useful management tool.

In Spain, four regional governments have an aquaculture strategy plan for both coastal and cage aquaculture: Galicia, the Canary Islands, Andalucía, and Cataluña. Galicia has created polygons for mussel aquaculture on rafts (Decree 406/1996, Regulation for Marine Cage Culture in Galician Waters) and defines the aquaculture polygon as “the delimited area in a maritime zone for raft/cage location”. Inside this polygon, the legislation defines the “square or delimited area inside the polygon for raft/cage location”. The Decree 423/1993 contains the rules for designing and managing these polygons.

According to the Law 2/2007 on fisheries and aquaculture, the Regional Government of Murcia established a series of polygons for cage aquaculture in designated maritime zones reserved for aquaculture activities and advised by different public administrations with jurisdiction in these areas.

In Cataluña, the coastal zone plan for aquaculture defines the map for setting up aquaculture facilities bearing in mind the proximity to the coast and excluding areas with *Posidonia*, marine protected areas, port zones, tourist areas, etc. Finally, Andalucía has published in 2006 the “Suitable Zones for Aquaculture Development in Maritime and Coastal Zones in Andalucía” identifying the incompatibilities between aquaculture and other coastal uses in order to contribute to the sustainable development of the activity.

Licensing process

The licensing legislation is very heterogeneous across the Spanish coastal regions. Each region has developed its own legislation with specific issues, both for licence granting and environmental impact assessment requirements, with different rules or systems. A summary of the licensing requirements and aquaculture policies in Spain will be presented, taking into account the differing regulation and the overlapping jurisdiction of different agencies.

Generally, cage aquaculture is subject to an authorization or concession for the activity granted by the Regional Government (Fisheries Department) jointly with the other licences or concessions required by current legislation for state-owned water occupancy. There are two formulas for granting a licence for cage aquaculture:

- public tender
- direct adjudication (e.g. Murcia Fisheries and Aquaculture Act 2/2007, Art. 84)

If marine cages are located in public domain, coastal or port zones, the licence is subject to obtaining a concession or a prior assessment report by the Ministry of the Environment. On the other hand the aquaculture licences need a previous environmental impact assessment. The most common licence granting system is the public tender which is a competitive process (e.g. in Andalucía, Murcia and Galicia). However, prior to the site tender, the licensing agency needs to obtain clearances from other administrations dealing with navigation, tourism, heritage, environment, ports, as well as from a number of local authorities. When the sites selected for aquaculture receive a positive assessment by all these departments, the lead agency starts the selection based on a set of fixed criteria.

In the case of the Canary Islands, the Fisheries Act establishes a set of conditions for obtaining a concession for cage aquaculture in the local waters (Art. 32, Fisheries Act, 2003):

1. public domain affected (state-owned property)
2. requirements regarding the use of this public domain imposed by the Ministry of the Environment via an assessment report concerning the use of the public domain
3. time period of the concession
4. type of species to be cultivated

5. environmental and sanitary requirements
6. production capacity

More interesting is the licensing procedure in the Region of Murcia (South of Spain). Murcia Fisheries and Aquaculture Act 2/2007, 7 March 2007, states the creation of marine culture polygons as zones reserved for cage aquaculture. The regional government designs polygons for aquaculture activity prior to granting the concessions. These polygons must be assessed by the Ministry of Environment, Rural and Fisheries Affairs (as the state-owned property responsible), and other administrations with jurisdiction in defence, navigation, tourism, ports, environment, coastal planning as well as a number of other local authorities.

Inside these polygons the concessions are granted by a public tender system. In these cases, potential concession holders do not need to submit an environmental impact assessment nor additional reports by the administrations mentioned above. Once a polygon is reserved for cage aquaculture by all the authorities involved in this area, the licence process becomes more simplified and with fewer requirements, simplifying also the process of site selection and management of the sites. The same occurs in Canary waters, where the procedure is shortened when cages are going to be placed in zones delimited by the Regional Aquaculture Management Plan (Art. 33, Canary Islands Fisheries Act, 17/2003).

All aquaculture cage promoters with allocation within the polygon are responsible for environmental monitoring and are obliged to delimit the zone with buoys (Art. 75, Law 2/2007).

In other sites outside the polygons, licences are subject to a prior environmental impact assessment (Art. 84.2, Law 2/2007) and a concession is granted only after being assessed by other administrations with jurisdiction over coastal areas: tourism, navigation, heritage, culture, environment, ports, coastal management and council or local authorities. Legislation allows two months for delivering this assessment.

The environmental impact assessment (EIA) process in Spain is carried out in accordance to EEC Directive 85/337, of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment, amended by Council Directive 97/11. The Directive specifically includes an assessment of the aquaculture impact and defines a format for an EIA including what is the minimum information it should contain (Appendix 1 of the Directive). In Spain, the autonomous regions have included EIA requirements into regional legislation. Each region has its own regulation on EIA with specific criteria and parameters varying between regions. The result is the existence of heterogeneous EIA processes throughout the country.

Experimental authorization

Regional and national legislation in Spain also include the so-called “experimental authorization”² that grants short-period licences for experimental or research aquaculture activities. The experimental authorization is only possible on test or pilot projects for new cultures, innovative projects or techniques not yet established or finalised. Normally this kind of authorization is granted for three years without the possibility of renewal and the authorized licence holder is not allowed to sell or commercialize the products obtained from the pilot project.

These kinds of authorization are awarded to stimulate new aquaculture initiatives. If the pilot project becomes a success, the licence holder is able to apply, on a preferential basis, for a definitive concession or authorization.

² Art. 19, Law 23/1984 on Marine Farming Activities; Art. 65, Galician Fisheries Act, 11/2008; Art. 54, Law 2/2001, Andalucía Fisheries and Aquaculture Act; Art. 84.3, Murcia Fisheries and Aquaculture Act, 2/2007.

Concessions effects

Aquaculture concessions and authorizations can be transferred, but not leased. Spanish legislation also requires insurance for licence holders, a payment of fees for state-owned property occupation or even an “exploitation fee” (Art. 31.3, Canary Islands Fisheries Act 17/2003). In this case, the value of this exploitation fee is calculated according to a set of criteria (cost of production, expenses for the sustainable development of the activity, recovery, etc.). Registration to the Aquaculture Register is also an obligation.

Aquaculture legal framework in Norway

Aquaculture in Norway has a long tradition as demonstrated over the past 45 years. Norway’s aquaculture industry is based on cage culture of salmon along its extended coastline. The Norwegian legal system is presented as a good example of how the legislative process has contributed to the development of aquaculture. The new Aquaculture Act of 17 June 2005 (in force since 1 January 2006) increases the legal security and competitive advantage of Norwegian aquaculture operators. The main changes introduced by the new Act concern simplification of the licensing procedure and administrative authorities involved. The Act was based on four fundamental pillars:

- growth of the industry
- simplification of procedures for industry and administrative authorities, increasing the efficiency and familiarity of said procedures
- a more modern and comprehensive environmental management system
- efficient use of the coast, attempting to reconcile coastal interests

All these principles are based on the mandate of improving coordination and administrative efficiency. Furthermore, the Aquaculture Act in Norway sets up a licensing system, including a specific licensing system for salmon and trout, which deals with issues like environmental standards, land utilisation, registration, transfer and mortgaging of licences, as well as control and enforcement.

In 2007 the Ministry of Fisheries and Coastal Affairs approved a strategy for a competitive Norwegian aquaculture industry. In this strategy, the government focuses on the industry need for a framework of conditions that contribute to maintaining the Norwegian aquaculture industry’s international leading position as a producer and exporter of seafood.

Licence granting

Cage aquaculture development in Norway is dependent on a licence. The conditions required for the granting of a licence are the following:

- an environmentally responsible project
- requirements concerning land use plans and conservation measures
- land use interest weighed
- complying with the Pollution Control Act, the Food Act, the Harbour Act and, for broodstock facilities, also the Water Resources Act.

Applications for establishment must also be presented to the municipality and evaluated in terms of coastal zone management plans in accordance with the Planning and Building Act.

As a key element, the Norwegian Act provides the limitation on the number of licences for salmon, trout and rainbow trout aquaculture. So, the Ministry in charge, the Ministry of Fisheries and Coastal Affairs, may prescribe:

- a. the number of licences to be allocated
- b. geographic distribution of the licences

- c. priority criteria
- d. selection of qualified applications
- e. licence fees

The Act also distinguishes between:

- a. salmon licences (for salmon, trout or rainbow trout as food), which are limited in number, distributed regionally and can be linked to industry or regional policy conditions; and
- b. other licences (e.g. other marine species including shellfish and hatchery-produced fish for restocking purposes), which are granted consecutively unless special legislation (traffic, fish health, pollution, etc.) or other concerns prevent this.

Today's system for salmon licences (for on-growing salmon and/or trout) consists of two groups of licences:

- a. non-commercial licences that comprise research, educational and exhibition licences; and
- b. ordinary commercial licences.

Licences are limited in terms of maximum allowed biomass (MAB). For example, a standard salmon licence is for 780 tonnes MAB up to, and including Nordland, and 900 tonnes MAB in Troms and Finnmark.³

The Directorate shall make a public announcement when the licences are being allocated. The announcement shall include basic criteria for the allocation, the deadline for application, requirements regarding the application, the licence fee, and a call on women to apply.

In 2008 a new administrative model for broodstock licences entered into force. The Ministry of Fisheries and Coastal Affairs enacted regulations introducing a new licensing scheme for broodstock designed as a new allocation and control system. The goal is to ensure that the licence holder has a sufficient economic and breeding-related foundation for such operation.

The main points are free and time-limited broodstock licences that are granted consecutively without special licensing rounds. This is how the Ministry ensures equal and sufficient access to roe for industry players, while at the same time contributing to equal establishment conditions for the players. The licences will be time-limited, but to ensure the industry sufficient predictability, they are given with a clear intention that they can be extended.

One-stop-shop

The regional administration, i.e. the Directorate of Fisheries, acts as a one-stop-shop for aquaculture licence applications. This administration is in-charge of all application procedures; however, many other administrations must evaluate the application with regards to their specific laws. Therefore, the Directorate of Fisheries will forward the application to all relevant authorities in order to obtain the required licences according to the above mentioned acts. These authorities are:

- relevant municipality in-charge of planning and construction issues
- the Food Safety Authority
- the County Governor
- the National Coastal Administration
- the Water Resources and Energy Directorate

³ Strategy for a competitive Norwegian aquaculture industry. Norwegian Ministry of Fisheries and Coastal Affairs, 2008. 20p.

At this point, the most important issue is to guarantee the efficiency of the licence process and coordination between the different administrations involved in the process. The Norwegian Aquaculture Act prescribes that all relevant authorities involved and including the municipality are obliged to efficiently coordinate the processing of a licence application.

Since 2003, an alternative model for coordinating and increasing the efficiency of application procedures within the aquaculture industry has been experimented with the so-called Trøndelag model. The model consists of delegating authority from the County Governor, the Norwegian Food Safety Authority and the Norwegian Coastal Administration to the Directorate of Fisheries, Region of Trøndelag (see Figures 1 and 2).

In Norway, the HASUT programme initiated a great deal of research on coastal issues, particularly related to the aquaculture and fishing industries. As part of this programme the aquaculture licence application process was reviewed and a new system was developed. The lead agency (the Directorate of Fisheries) increased their resources and proficiency in vetting the applications. The result has been a decrease in the processing time from 20 months to 1.5 months, with no reduction in the quality of the process. A graphical representation of the streamlined process is shown below.⁴

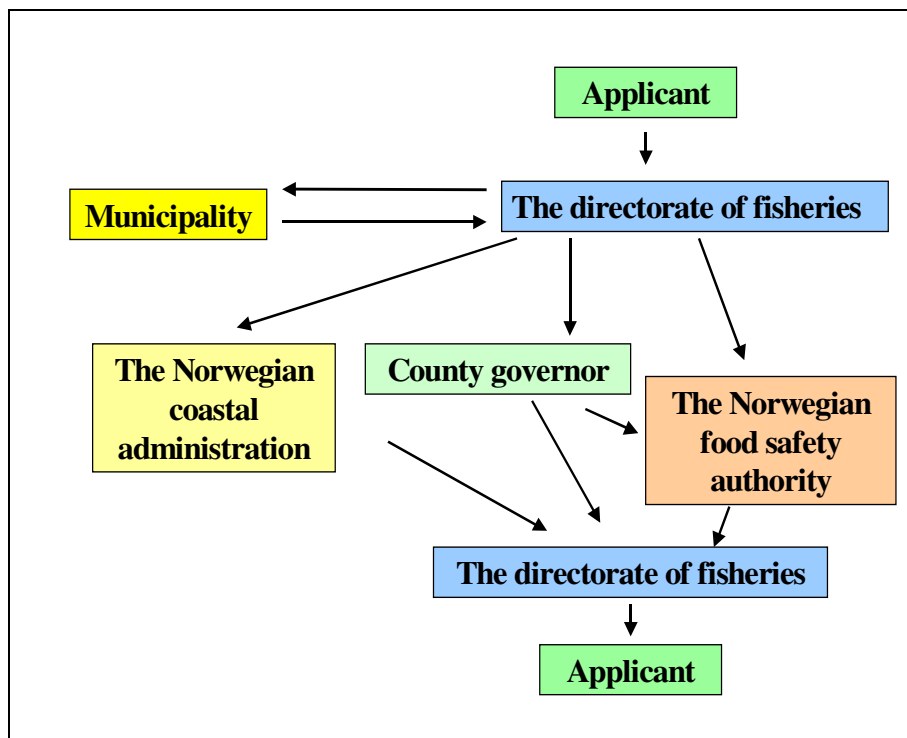


Figure 1. Old model for licences granting (Source: CZM Project INTERREG IIIC)

⁴ Coastal Zone Management, INTERREG IIIC Project, within the AQUAREG programme. Lead by the Irish Marine Institute (BMW). Ireland, 2007.

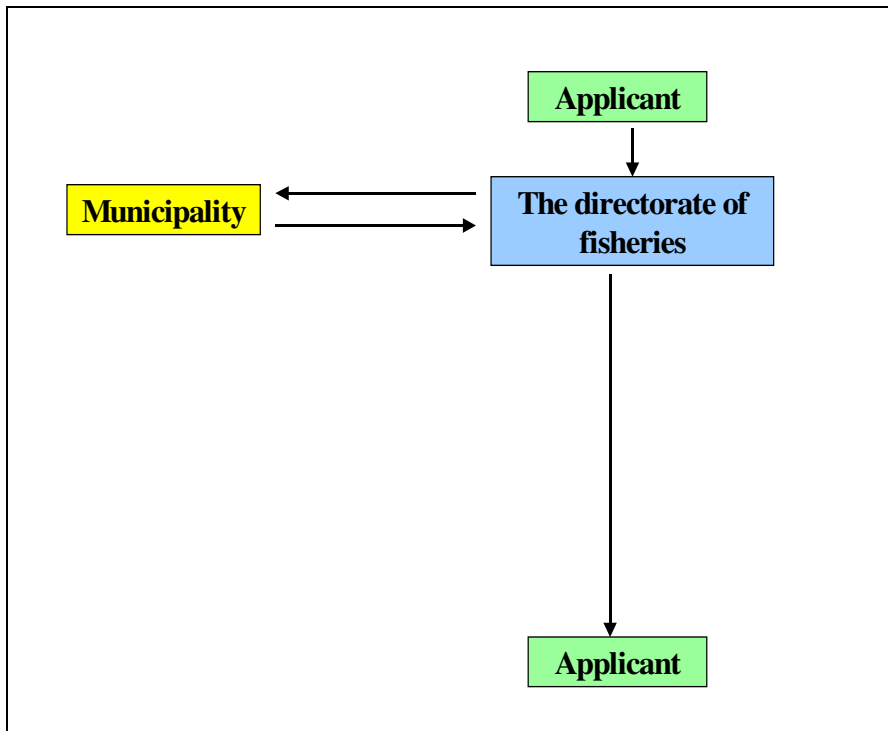


Figure 2. New model – Trøndelag model (Source: CZM Project INTERREG IIIC)

Licence requirements

- a) People engaged in aquaculture activities shall have the necessary professional background (basic aquaculture education or two years of working experience in charge of an aquaculture facility). Other professional requirements are related to the necessary knowledge of how to prevent, detect and limit the escape of fish. The facility shall also be sufficiently staffed with employees capable of ensuring proper fish welfare.
- b) For mussel culture the applicant needs to pay a deposit of USD 415 for each acre where aquaculture will be carried out, or show that the applicant has taken out an insurance of the equivalent amount. This deposit or insurance shall serve as a security that the site will be restored when the production is discontinued.

The Ministry of Fisheries will allocate 65 new licences in 2009 along the Norwegian coast. Licences will be granted at a fixed cost and applicants will be prioritized on the basis of certain criteria:

- small- and medium-sized operators in the industry
- operators who will promote value-adding processing along the coastal districts of Norway

Content of the licence

The Ministry sets up detailed provisions regarding the content of aquaculture licences including scope, time limitations, etc., while licensing regulations establish a maximum breeding biomass for each licence.

The Ministry may amend or revoke aquaculture licences if:

- a) it is necessary due to environmental considerations
- b) there are changes in the facility

- c) in the event of gross or repeated contravention of the provisions prescribed in or pursuant to the Aquaculture Act
- d) if the licence is not used or only used to a limited extent
- e) if one or more of the licences required pursuant to the acts listed in Section 6, Paragraph 1, Letter d, has lapsed

Transfer of licences and mortgaging

The licence can undergo changes in ownership through a transfer of the licence according to the Aquaculture Act 2005. Nevertheless the leasing of aquaculture licences is not permitted. Aquaculture licences may also be mortgaged. The mortgage will be afforded legal protection when it has been registered on the licence's record on the aquaculture register. The State's mortgage takes precedence over any other encumbrances on licences for claims, for enforcement damages, claims for the reimbursement of execution expenses, and for violation fines pursuant to the Act.

Aquaculture register

Each individual licence shall have a separate record in the Aquaculture Register.

Environmental requirements

Environmental requirements are very strict in Norway. The country has developed a complete regulation regarding environmental issues and how to integrate them in a coordinated manner into the licensing process.

Environmental provisions are in a separate chapter in the Aquaculture Act. Environmental aquaculture issues are considered relevant both prior and after the granting of an aquaculture licence. According to the Aquaculture Act (2005) an aquaculture licence will only be granted if it is "environmentally responsible". Therefore, Chapter III of the Aquaculture Act addresses environmental considerations and the establishment of an environmental standard for aquaculture operations in Norway, by providing that aquaculture facilities shall be established, operated and abandoned in an environmentally responsible manner.

The application for a licence should include the following:

- a) information regarding the currents of the site;
- b) for marine aquaculture: map documentation as prescribed in the standard NS 9410 ("Environmental survey for marine fish farms", or as prescribed in equivalent international standards);
- c) for marine aquaculture: the results from an environmental survey of the seabed of the site as prescribed in the standard NS 9410 or as prescribed in equivalent international standards.

The current EIA provisions implement the Council Directive 97/11/EC on EIA. An EIA may be required for a movable/floating marine salmon farm with a volume of 48 000 m³ or more, or a permanent marine farm site with a volume of 36 000 m³ or more, according to criteria listed in Section IV of the Norwegian Regulations. If the competent authority decides that an EIA is required no permit will be granted until the requirements have been fully satisfied.⁵

⁵ Assessment of regulatory and practical approaches to Environmental Impact Assessment and Environmental Monitoring of marine cage aquaculture of salmon in Canada, Chile, Ireland, New Zealand, Norway, United Kingdom and the United States of America. FAO Technical Workshop on Environmental Impact Assessment and Monitoring in Aquaculture, September 2008, page 17.

Aquaculture legislation overview in Greece – Licensing procedure

Legal framework for aquaculture and licensing procedure in Greece is characterized by the absence of a specific coordinated aquaculture policy and time-consuming and complex procedure for granting a licence. There is a lack of maritime or coastal zones reserved for aquaculture activities, which could avoid this delayed and lengthy procedure.

In Greece, the competent administrative authority in aquaculture is the Ministry of Agriculture, but there are other administrative public bodies involved in the process: the Merchant Shipping Ministry, the Ministry of Development and the Ministry of Environment, Physical Planning and Public Works. However, when the use of marine waters is concerned, as well as the aforementioned ministries, the intervention of the Ministry of Culture, the Ministry of National Defence, and the Ministry of Health and Welfare is required. The involvement of so many agencies and authorities results in lengthy procedures that may take between two and three years for a licence to be processed.

In Greece and in some Spanish autonomous regions, the number of documents required and copies of those documents can exceed 8 copies for the Ministry of Fisheries and Agriculture, 3 copies for the Land Use Planning Office of the Ministry of the Environment, and a third application with 3 copies for the environmental impact assessment.

The basic legislation for aquaculture is some 20 years old and was designed principally for the exploitation of freshwater and lagoons. The normal period of lease is 10 years and the zones prohibit fishing activity in an area of up to 200 m around the cages.

In 1998, the Greek National Aquaculture Development Plan was published which clearly promotes the development of aquaculture. Since then a permanent Coordination Committee was established with an official mandate to promote and support aquaculture development in the country. The National Aquaculture Coordination Committee (NACC) includes representatives from all relevant ministries and is in charge of:

- decentralization of aquaculture support services and promotion of regional initiatives
- simplifying procedures for acquiring grants and loans
- streamlining licensing procedures
- introducing and implementing regulations that controls pollution that may affect the industry
- formulating simple procedures for the acquisition of financial assistance

Licensing granting process

Aquaculture in Greece needs a licence for the establishment and operation of a fish farm. The leasing and licensing procedure for an area starts with the submission of an application to the authorized service: the Department of Fisheries and Aquaculture of the Ministry of Agriculture. The application has to be presented with eight copies of a map for the major marine and land area, a site chart, a preliminary feasibility study (brief technical and economical survey with basic information on the farm design, number, type and size of cages, species to be produced, expected production and an outline of the production plan). A description of the underwater topography of the site is also required, with a profile of the net-cages in relation to the water depth (Figure 3).

At the same time, a second application has to be submitted to the Ministry for Environmental, Physical Planning and Public Works to obtain a pre-approved permission for the use of the site. This application has to be presented with three copies and also has to include a topographical map and bathymetric chart of the site, photographs, a feasibility study and a public questionnaire. Furthermore, the current practice calls for consultation of additional departments and interested local parties engaged in coastal navigation, tourist and other sectorial interests.

Before the final approval and permission to initiate the project, a third application needs to be submitted to the Ministry of Environmental, Physical Planning and Public Works. Four copies of an environmental impact assessment (EIA) report must be attached to the application along with the positive pre-approval for the use of the site from the land use planning office from the same Ministry. Finally, the local prefect grants the final positive decision and leases the site to the operator.

The Aquaculture sector in Greece complains that there are far too many competent authorities involved; that it takes too long for a licence to be issued and that there are many conflicts with other users of the same area.

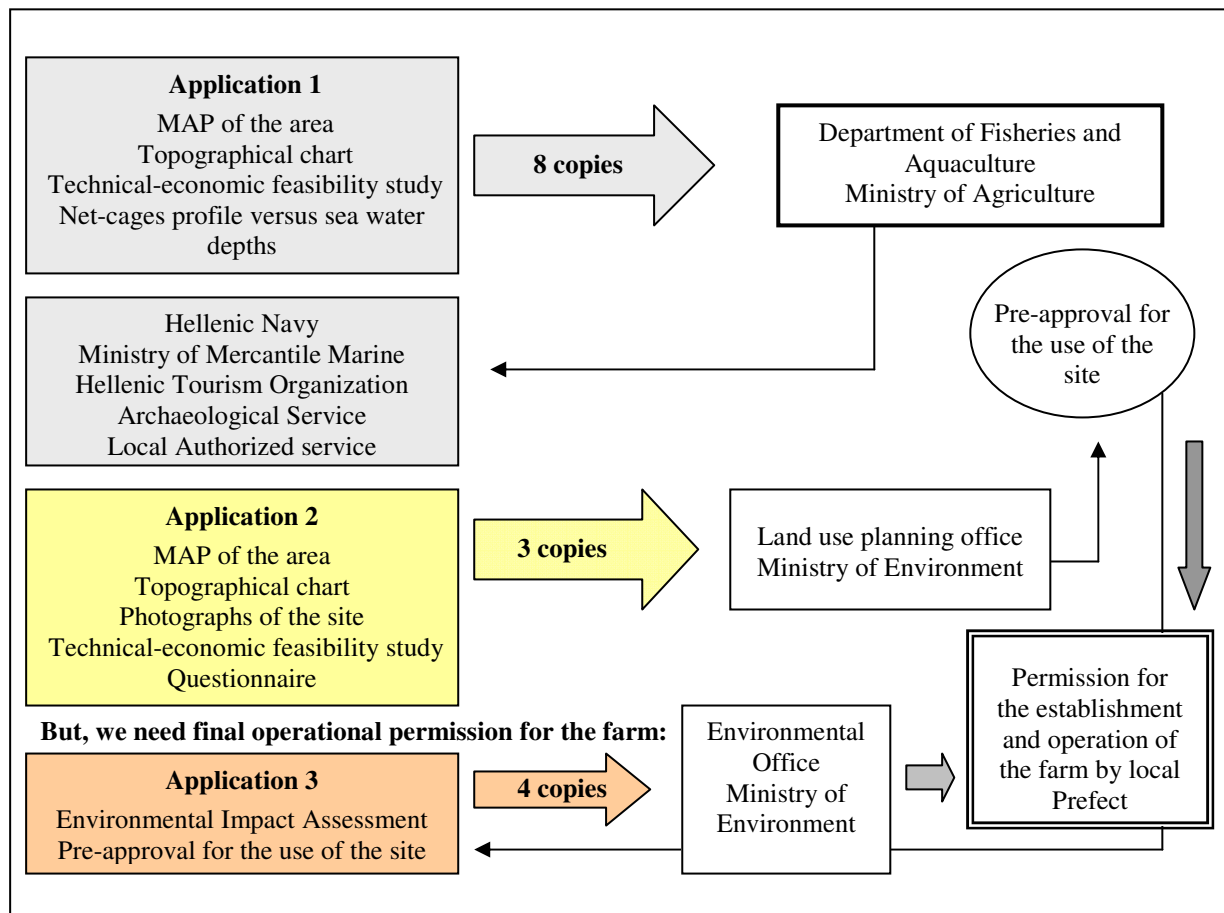


Figure 3. Licensing procedure for finfish cage farms in Greece (Source: Papoutsoglou, 2000)

One of the major problems faced by the marine cage aquaculture industry in Greece is the competition from other resource users. There is no provision for the protection of an investment against future establishment of a competing industry or other activities in the same locality. Fish and shellfish farming projects could be eliminated by unforeseen industrial developments and some provision should be made for their protection. A possible solution could be the creation of zones reserved for aquaculture development where this activity has a clear priority status. In addition, such zoning would have the additional advantage of making individual applications considerably less complex. The prospective developers would not have to seek the agreement and permission from different departments.

Aquaculture legal framework in Chile – An overview

Salmon farming in Chile is expanding rapidly, and this country is now the second largest producer of salmonids in the world.⁶ In Chile, cage aquaculture is regulated under the general legal framework for aquaculture. No distinction is made with regard to cage aquaculture. The only distinction refers to the location for developing aquaculture: water column, beaches, public coastal areas, etc., or the type of property: state-owned property needs a concession, and for the rest of the areas or private areas an authorization is needed. A similar situation takes place in many regional governments in Spain.

Chile has a complex regulation in terms of licensing with an efficient granting procedure and, in terms of environmental protection, with a comprehensive environmental impact assessment procedure. A legal framework on aquaculture further facilitates the granting of farm licences and the development of the industry as a whole.

Types of licences and administrative authority

The Sub-Secretariat for Fisheries is the authority in charge of granting aquaculture authorizations, for developing the activity while the Ministry of Defence is the authority in-charge of granting concessions for aquaculture activities over state-owned properties. In these areas, the Ministry of Defence shall set up by decree suitable areas for aquaculture development. SerNaPesca, the National Fisheries Service agency, is responsible for maintaining a national register of all aquaculture facilities.

Who can apply for a licence?

Only individuals of Chilean nationality or foreigners with permanent residence in the country, and Chilean legal entities, established in accordance with Chilean law, may apply for aquaculture concessions and/or authorizations.

Requirements for obtaining a licence:

- The aquaculture promoter must present an application form with the documents required (applicant identification, maps of concession site, reports from the navigation authority, technical project, proof of professional and technical skills and experience);
- Aquaculture activity must be developed in areas designated as appropriate aquaculture zones by the Ministry of Defence.

The Ministry of Economy established the Ministry Assessment Commission for Salmon Culture in June 2008. The Commission is in-charge of, among other aspects, designing a map of sites for aquaculture development. The Chilean Government has also established a Geographic Information System to identify the polygons with concessions granted in the different regions of the country.

Granting procedure

In 2003 the National Aquaculture Policy (Política Nacional de Acuicultura, PNA) was implemented as a legal framework to regulate the system and streamline the various policies and legal bodies that regulate aquaculture activities. As a result a “one-stop-shop” has been established for the processing of the necessary paperwork, permits and licences; most of this can be done via Internet.

The licences for cage aquaculture depend on the place where the cages will be located (private property or state-owned property). Applications for aquaculture concessions and authorizations have to be filed with the Sub-Secretariat for Fisheries. Applicants must provide a technical project, together with the supporting documentation required by the regulations.

⁶ La acuicultura en Latinoamérica; www.mundoacuicola.com

The Sub-Secretariat shall verify the absence of a prior concession or authorization in the same area, as well as the compliance with the conditions and requirements stated in the law. In particular, the approval of an application is subject to the compliance of the project with the requirements established by the Ministry of Economy, such as the environmental measures to be taken to ensure that the development of aquaculture facilities does not exceed the carrying capacity limits of each water body or the maximum size of aquaculture areas (Figure 4).

The Environmental Regulation for Aquaculture was responsible for the introduction of the concept on Preliminary Site Characterization which requires new applications to submit an environmental impact assessment (EIA) report. Furthermore, all existing farms must also conduct annual environmental monitoring as part of an environmental information programme. The Preliminary Site Characterization authority indicates the environmental information needed from an aquaculture facility including physical, biological and chemical parameters and a series of variables from the project area; information on the planned production system and projected annual production is also required.

According to the General Law for the Environment (1994), applicants must submit an environmental impact statement in a period of 150 days to the Regional Environmental Commission. This period can be extended to one year in the case an environmental impact assessment is required (Art. 14, Regulation on Concessions and Authorizations for Aquaculture, No. 290, 28 May 1993). Following the submission of the EIA, and in the case of cage aquaculture concessions, the Sub-Secretariat for Fisheries must send the applications, within 30 days, to the Sub-Secretariat for Marine Affairs of the Ministry of Defence for final decision. The Ministry of Defence has 90 days to make a final decision for granting the concession (Art. 14–16, Regulation 1993). After obtaining the concession or authorization, the applicant has 45 days to publish the resolution in the Official Bulletin.

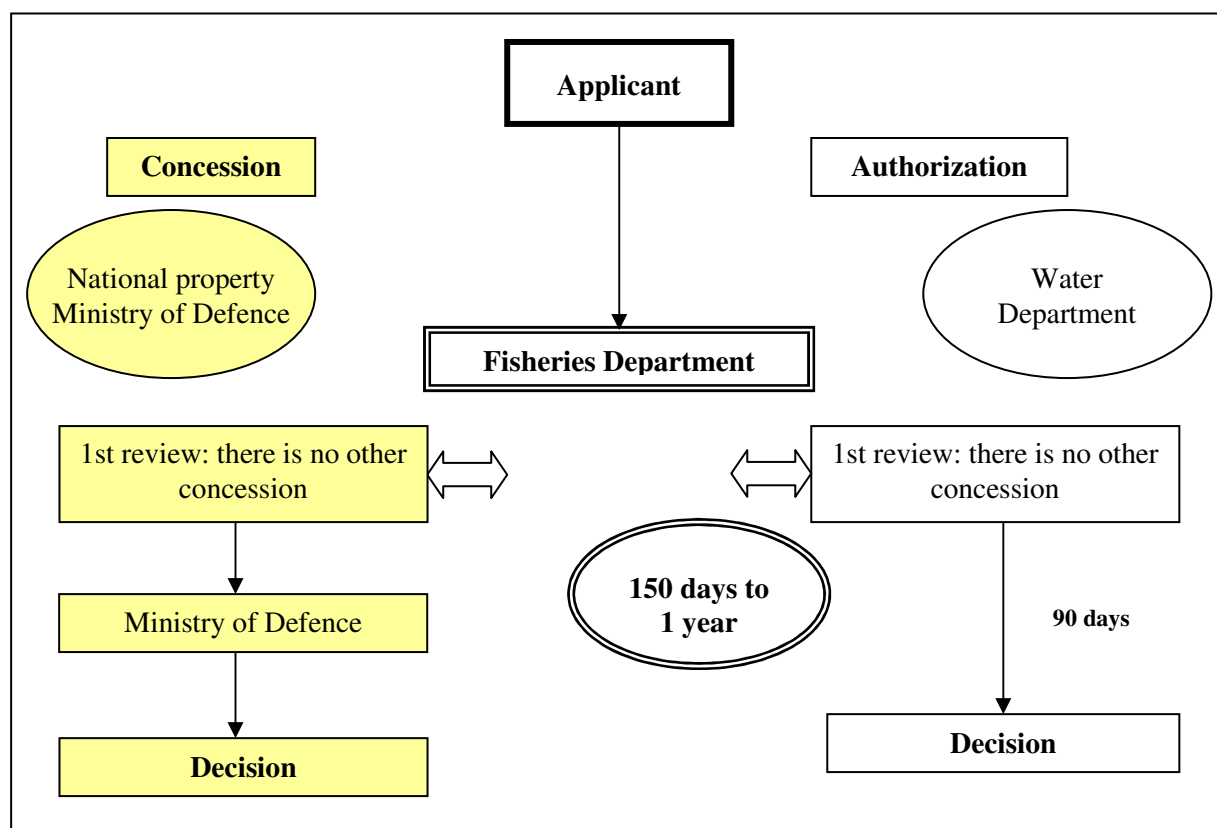


Figure 4. Aquaculture licence procedure in Chile

Concessions for cage aquaculture are issued for an unlimited time. This lack of time limit may guarantee the economic activity of aquaculture in Chile. Nevertheless, these concessions may be revoked if licence conditions are not being observed by the licence holder.

All aquaculture concessions and authorizations must be registered in the National Aquaculture Register before starting operations. The Register is kept by the National Service for Fisheries and concession holder must also pay an annual aquaculture fee (Patente Única de Acuicultura), according to the Fisheries and Aquaculture Act (Art. 84).

The Licence holder may transfer or lease the concession with the prior permission of the Fisheries Administration (Art. 25, Regulation 1993) or modify the structure of the facility. Concession and authorized licence holders may apply for modifications to accommodate one or more additional species directly to the Sub-Secretariat for Marine Affairs and the Sub-Secretariat for Fisheries.

Environmental impact assessment

In general, aquaculture is subject to an environmental impact assessment. The General Law on the Environment 19.300, amended by Law No. 20.173, 2007, states that any project implying, amongst others, the cultivation of living aquatic resources, and the installation of plants for the processing of those resources is subject to an EIA (Art. 10). Regulation No. 95 of 2001 stipulates that aquaculture projects are subject to the environmental impact assessment, with the exception of minor projects. For fish cages the regulation demands an EIA for annual production equal or superior to 35 tonnes, when the aquaculture activity is for echinoderms, crustaceans, molluscs, fish and other species, through an intensive system of production. Voluntary submission to the EIA regulatory body is also admitted.

The EIA procedures are administered by a regional or national environmental commission. Applications are to be filed either with the Regional Commission or the Executive Board of the National Commission, depending on whether the environmental impact is located in one or more regions. Upon approval of an EIA report or statement, an environmental permit will be granted.

The Chilean National Commission for the Environment (CONAMA) is one of the coordinating tools utilized in Chile to make the licensing procedure more efficient. This coordinating agency represents, under the Framework Law on the Environment (1994), thirteen State ministerial departments and holds regional representation in the Regional Commission for the Environment (COREMA). CONAMA is responsible for coordinating environmental policies and proposing regulations.

When a project or activity that is subject to the EIA procedure is likely to cause one of the impacts listed below, an environmental impact study is required, otherwise an environmental impact declaration (or statement) shall suffice.

- risks to human health as a result of the effluents or waste matter produced by the project;
- significant adverse effects over the quantity and quality of renewable natural resources, including soil, water and air;
- resettlement of human communities, or significant alteration of the life system and customs of the local communities;
- location close to human settlements, protected areas or other areas where the environmental value of the area is affected;
- significant alteration, in terms of magnitude or duration, of the scenic or tourism value of an area;
- alteration of monuments, anthropological, archaeological or historical sites of interest and, in general, to any cultural heritage areas.

The environmental impact studies must include the following content, according to the Regulations of the EIA procedure: a description of the project; a plan of compliance with the relevant environmental legislation; an estimate of the environmental impact of the project, including possible risks; a

mitigation, repair and/or compensation plan; and a monitoring plan of the main environmental variables for which the environmental impact study is required.

Aquaculture licensing regulation in the United States of America – An overview

Aquaculture in the United States of America is regulated at federal and state level. The interest in aquaculture is relatively recent in many states, where the legislation is more detailed. Lead agencies with authority to grant licences are located in the individual states but there are also federal agencies involved in aquaculture regulation:

- the Food and Drug Administration
- the Department of Health and Human Service (DHHS)
- the Environmental Protection Agency
- the National Oceanic and Atmospheric Administration (NOAA)

In 2007 the National Oceanic and Atmospheric Administration (NOAA) adopted a 10-Year Plan for Marine Aquaculture as an agency-wide policy document. This plan is intended to guide the agency as it works toward establishing marine aquaculture as an integral part of the US seafood industry and as a viable technology for replenishing important commercial and recreational fisheries. The plan provides specific goals for the NOAA Aquaculture Programme, specifically those related with licensing issues:

- a comprehensive regulatory programme for environmentally sustainable marine aquaculture
- the development of commercial marine aquaculture and the replenishment of wild stocks
- public understanding of marine aquaculture
- increased collaboration and cooperation with international partners

Following this general policy, most of the states started to develop tools for improving their legislations, focusing on three fundamental areas:

1. the design of an aquaculture policy
2. simplification of the procedure for granting licences
3. including aquaculture in coastal zone plans

Although the majority of European countries have not completely resolved their coordination problems, countries such as the United States of America and Canada have opted for the creation of inter-institutional coordination offices or agencies. In its Strategic Plan for Aquaculture (2007), one of the NOAA's priorities is to coordinate procedures for aquaculture licences in coastal areas, ensuring both internal coordination and coordination with other federal agencies. This will make the NOAA responsible for granting licences for aquaculture in federal waters and coordinating the actions of other agencies that grant aquaculture licences. In the State of Florida, an Aquaculture Division has been created, that acts as a "one-stop-shop" for marine and continental aquaculture, centralizing all legislative activities and the Aquaculture Certificate of Registration. Moreover, in this State, the Aquaculture Interagency Coordinating Council has been created which serves as a forum for the discussion of aquaculture policies and coordinates the activities of the five departments involved in the aquaculture sector. The Council is also responsible for preparing proposals to foster the development of aquaculture.

In Florida, producers have agreed to adopt a document setting out best management practices for aquaculture (BMP), which is designed to eliminate overlapping between the agencies and authorities involved, the duplication of licences, etc. The State of Maine, meanwhile, has set up an Aquaculture Policy Ombudsman in the Department of Marine Resources which, among other duties, is in-charge of coordinating state policies in aquaculture and liaises with the Interagency Committee on Aquaculture.

This report focuses on the analysis of the aquaculture regulation in the State of Maine (United States of America), as a good example of clear and complete regulation. Furthermore, Maine aquaculture

regulation and licensing guidelines are available to all investors and interested parties in the Web site of the Government.

The Department of Marine Resources (DMR) has a dual role of protecting and promoting the sustainable use of Maine's marine and estuarine resources. In 1973, to meet this objective, the State developed a set of aquaculture laws designed to manage this new industry. The Maine Aquaculture Laws provide the Department of Marine Resources with the authority to lease state-owned waters to private interests for the purpose of conducting aquaculture activities. These regulations clearly define the role of DMR in the administration of aquaculture lease sites.

Licences in Maine are described in two different ways: leases and licences. The Department of Marine Resources grants two types of leases and one type of licence. A lease or licence gives a farmer legal protection for their activities and products. The three permits are:

1. Limited-purpose leases
2. Standard leases
3. Limited-purpose aquaculture license

Limited-purpose leases: These are frequently called experimental leases. They are small in size (up to 2 acres) and short in duration (up to 3 years). They were created to allow for commercial and scientific research with shellfish or finfish before a longer or larger lease is required. These leases are granted with less application requirements and do not require the same level of review as standard leases. Limited-purpose leases cannot be renewed unless they are for scientific research. A limited-purpose lease for commercial research expires at the end of the 3-year period. The leaseholder may then apply for a standard lease.

Standard leases: Standard leases are larger (up to 100 acres) and longer in duration (up to ten years) than experimental leases, and they can be renewed and transferred. Because the State is interested in developing a diversified aquaculture industry there is a limit of 300 non-fallowed acres for standard leases that can be held by any one tenant. Standard leases are issued for bottom and suspended culture for rearing shellfish, finfish, and seaweed.

Limited-purpose aquaculture licence: The limited-purpose aquaculture (LPA) licensing programme provides applicants with the opportunity to obtain a 1-year licence to rear any of five specific species of shellfish (mussels, oysters, soft-shell clams, quahogs and hen clams) using particular gear types that cover no more than 400 square feet. Because the licence is specific to certain gear and certain species on a very small area, licences can be approved without the extensive review that is required for either an experimental or standard lease. The intention of this programme, developed at the suggestion of shellfish growers two years ago, is to streamline the permit process so that growers can "try out" different locations prior to applying for a lease.

Lease application process⁷

- a) Pre-application meeting. Prior to completing the application, applicants must arrange a pre-application meeting.
- b) Pre-application scoping session. Prior to submitting the application, applicants are required to hold a public scoping session. This will be an informal public meeting intended to familiarize the public with the proposal, receiving information and feedback from the public, providing the Department with information prior to the site review.
- c) Submit application. Applicants submit the application to the Department of Marine Resources. If the application is complete, the DMR will forward the application to other regulatory agencies, the municipality and riparian landowners.

⁷ DMR regulations, Chapter 2 and 12 M.R.S.A. § 6072

- d) DMR site review. Applicants will be contacted to schedule a site review of the proposed lease area. This review will be an on-site inspection of the proposed lease area. A number of environmental measurements and a SCUBA dive will be made on the site. DMR staff will prepare a report of the site review.
- e) Public hearing. An adjudicatory aquaculture lease hearing is a requirement for all applicants under the DMR Aquaculture Lease Regulations. Maine Government allows public participation in aquaculture leasing through the Web site. The Department of Marine Resources encourages the public to speak at hearings.
- f) Public notice. The Department will issue public notice of the hearing. At least 30 days prior to the public hearing, the applicant shall place visible markers that delineate the area proposed to be leased.
- g) Decision. The DMR Hearings Officer will prepare a report including proposed findings of fact, conclusions of law, and if requested by the Commissioner, a recommended decision to grant or deny the lease. The Hearing Officer's proposed decision will be sent to all legal parties, who will have 10 days to comment on the proposed decision. The Commissioner will make a final decision to grant or deny the lease within 120 days of the public hearing.

After a licence is granted the licence holder must comply with the following requirements:

- establish an escrow account or secure a performance bond in the amount required by DMR in the lease
- record the lease in the Registry of Deeds
- publish a notice in a newspaper of general circulation in the area affected
- mark the lease site with the appropriate buoys
- submit to the Commissioner an annual report of lease activities
- pay the annual rental fee of USD 100 per acre

Revocation. The Commissioner may commence revocation procedures if he/she determines that substantial aquaculture has not been conducted within the preceding year or that the lease activities are substantially injurious to marine organisms. If any of the conditions or requirements of a lease are not being observed, the Commissioner may revoke the aquaculture lease.

Transfer. Leaseholder may apply for approval from the Department to transfer the aquaculture lease to another person for the remaining portion of the lease term. A lease transfer shall be an adjudicatory proceeding.

Renewal. A lessee must file with the Department an application to renew a lease no later than 90 days prior to the lapse of the prior lease. Renewal of a lease shall be an adjudicatory proceeding.

The State of Maine has designed an Aquaculture Lease Inventory that shows where the farms are located, as well as provide contact, harvest and lease information. The inventory is updated in the Government of Maine Web site.

LEGAL FRAMEWORK FOR AQUACULTURE – KEY ISSUES AND AREAS OF REGULATION

As mentioned in previous paragraphs, regulation in aquaculture activities is by far the most important aspect required to develop the activity in a sustainable manner. In some developed countries with a long history and several types of aquaculture, as in Spain, the last three decades have demonstrated that an aquaculture legal framework is an important element to ensure the sustainable development of aquaculture. In this latter country, reports and surveys collected for the elaboration of the Spanish Strategic Aquaculture Plan focused on giving a coordinated and homogenized aquaculture policy in the different Spanish regions, pinpointing three problems to be solved in order to achieve a more competitive aquaculture industry:

1. the complex and time-consuming permit process
2. the variety and large number of laws, regulations, directives, etc., that aquaculture promoters must comply with
3. the lack of coordination between the authorities involved in the licence process⁸

Aquaculture is governed by different regulations depending on the specific characteristics of the zones it occupies: onshore, inshore or offshore. Different authorities have jurisdiction over these zones and they may draw up diverse and sometimes distinct regulations. The scale of the influence and intervention of the administrative authorities depends also on the degree of decentralization and the impact of various regulations at different administrative levels: local, regional, European Union (or European) and, in some cases, international.

Aquaculture legislation and coastal management planning are important to investors as they not only make it cheaper to find information but also provide them with a firm basis for decision-making. The importance that an administration or government confers to aquaculture can be easily ascertained by the existing level of regulation or planning in this field. A country which has not developed any specific rules or clear procedures is not likely to consider aquaculture at present a strategic sector for development.⁹

The role of providing a legal framework for aquaculture falls to aquaculture agencies or departments; they are usually the fisheries administrations, such as the Ministry of Fisheries or the Regional Fisheries Departments. These authorities or agencies have the power to define the location of aquaculture facilities, the types of operations and practices allowed at these locations, and the species that may be farmed. In short, administrations design the policy for aquaculture containing the main aspects which define aquaculture in a country, underlining the aquaculture national interests.

This is the traditional function and role of an aquaculture department; however they often play another important role in addressing environmental impacts of aquaculture operations and to resolve conflicts between aquaculture and other users of state-owned waters. They should establish an appropriate aquaculture coastal plan selecting zones for this activity and solving the problems of interaction between other coastal activities, i.e. tourism, fishing or navigation.

Areas of regulation

The legal framework for aquaculture is not limited to the sectorial regulation of this activity, i.e. the conditions and characteristics of access to the activity in the form of licences and permits, validity periods, the rights and duties of established operators, the characteristics of aquaculture facilities and their production systems, etc. Furthermore, we must implement additional important rules that, although not issued by the administrative authority, directly affect the development of this industry. Therefore, there are other areas of regulation that also affect the industry, particularly: legislation on health, environmental impact and management, marketing of aquaculture products, and so on. For example, at the European level there are more than three hundred rules that affect this industry.

This paper however focuses on the legislation concerning licences, and the spatial planning and use of public areas. The author also refers to important, wide-ranging legislation on the occupation and exploitation of public-owned coastal areas (identified with different names depending on the country) or legislation on state-owned coastal areas, in which concessions must be granted for the development of aquaculture. This is the case of the majority of Mediterranean aquaculture regulations (Algeria, Egypt, France, Greece, Italy, Spain, Turkey, etc.), which are normally issued by a different authority than the one that grants aquaculture licences.

⁸ Spanish Strategic Plan for Aquaculture 2007–2015, Ministry of Environment, Rural and Maritime Affairs, Secretaría General del Mar (General Secretariat of the Sea, 2008).

⁹ “Current US law does not provide clear mechanisms to allow commercial aquaculture operations in federal waters, three to 200 miles off the coast. That regulatory uncertainty is widely acknowledged as the major barrier to the development of aquaculture in federal waters” as declare by NOAA with reference to the National Offshore Aquaculture Act 2007.

As aquaculture is an economic operation that entails a risk and requires high levels of investment, aquaculture operators must be informed of and clearly understand the legal requirements and associated costs. They also need to be notified of matters relating to the appropriate locations for setting up aquaculture establishments. This information includes: the conditions and requirements that will be demanded by the agencies involved and who have decision-making power; the criteria used to calculate the taxes and fees; the sums that operators can expect to pay; the environmental protection measures required; and finally, the rights that operators will acquire and the guarantees in place to protect those rights vis-à-vis third parties.

Not all the countries have rules on aquaculture activities and the legal situation is very heterogeneous, with regard to both the existence of regulations and their contents. Most Mediterranean countries have developed a complex legal framework for aquaculture and some of them, such as Algeria, Egypt and Spain, have a specific act for aquaculture, although the majority regulate fishing and aquaculture jointly (Croatia, Greece, Malta, Morocco, Turkey and many Spanish autonomous regions). On the other hand, other countries like France regulate aquaculture through lower-level regulations such as decrees.

Nearly all of these regulations contain numerous gaps, and it is widely agreed that there is a lack of coordination and significant overlapping between administrative authorities, resulting in over-bureaucratisation. Therefore, it is necessary to find mechanisms that ensure proper coordination between these authorities, as the absence of such mechanisms may have negative impacts on the development of the industry.

Countries including Canada, Norway and the United States of America have a specific law for aquaculture: Norway (Aquaculture Act, 2006); Canada (Aquaculture Act, 1988); United States of America (National Aquaculture Act, 1980 and National Aquaculture Offshore Act, 2005).

AQUACULTURE LICENSING PROCESS

General principles governing the exercise of authority to issue a licence

As marine cage farms are usually established in areas defined as “coastal and maritime public domain”, i.e. state-owned property, they need to be authorized by the competent administrative authorities in charge of managing such spaces. In general, this coastal zone belongs to the society as a whole for general use, but when a profitable or economic activity (as private activity) is developed in these areas, a concession or permission by the authority responsible in these zones is needed.

The licensing system is a control procedure that allows the authorities to verify the viability of the installation site and the potential environmental effects of the operation in question. Licences establish aquaculture sites, the conditions and operating period, environmental requirements and the carrying capacity of each aquaculture facility, i.e. the conditions that affect the specific area where aquaculture will be practised.

There are various types of licences, depending on the type of activity or the legal status of the aquatic resource used. They have different names, such as: authorization, concession, licence, permit or lease. Generally, in nearly all countries, the most commonly used terms are: *licence*, referring to the activity, and *concession*, referring to occupation of public areas. Definition depends on the legal system in each country.

Who needs an aquaculture permit?

The permit is the tool established for managing aquaculture, for planning cage and other aquaculture activities and for controlling their operation. Normally cage aquaculture is developed in stated-owned waters; therefore promoters need a special permission to occupy such areas with the right of use and exploitation. Therefore, an individual or legal entity needs a licence for developing aquaculture. If the

activity is located in private waters or land-based, the licence also guarantees control of the activity also with regards to health and sanitary issues, and marketing.

Criteria for selecting an application

More recent rules and regulations for cage aquaculture include rules for the public tender in order to introduce a range of criteria helping to select the applicant who best fulfils the conditions proposed by the competent authorities. These criteria are usually set up when the activity requires public domain occupation. The criteria will help select the best application for an aquaculture concession. The range of criteria considered by the majority of aquaculture legal frameworks are the following:

- aquaculture contributes to the development of the region or, as the Andalusia Law (Spain) states “the socioeconomic importance of the aquaculture project” (Art. 49, Law 2/2002, 4 April, on Managing, Monitoring and Promoting Fisheries and Aquaculture in Andalucía, Spain).
- contribution to job creation, particularly contracting professional fishermen and women. The Andalusia Law highlights the following aspects: socioeconomic importance of the project; experience in aquaculture activities; new technologies and low environmental impact; food supply to the European market; and involvement of fisheries associations.

In Australia, the criteria assessing the aquaculture tenure allocation include: “the nature of the proposal, the economic benefit to the state, the technical and business capacity of the applicant, the environmental management capacity and other relevant criteria published by the Minister”.¹⁰ The Croatian laws also include the following criteria: the concession fee offered; the overall investment amount; social criteria (the number of people to be employed); environmental concerns (the investment for environmental protection).

Licensing procedure

As mentioned, marine cage aquaculture is developing in public areas managed by public authorities; therefore besides the operating licence authorizing the aquaculture production, the promoter usually needs a concession to occupy a public area. In some countries like Chile, some regions in Spain and Norway there is only one permit that includes both authorization for allowing the activity and occupation concession of the area. These permits need a more complex procedure.

In the case of Spain, the regional government departments responsible for aquaculture grant the operating licences. However, these licences must be complemented by the concession or by a binding report on the occupation of the water public area, which must be granted or issued by the Ministry of the Environment.

In France, there is a similar system based on two separate forms of authorization: a marine culture licence (“Autorisation d’exploitation des cultures marines”) granted by the Maritime Affairs Office, and a licence required for facilities producing more than 5 tonnes/year the legal status of which depends on the capacity of the facility.

In Malta, for offshore aquaculture, two permits are required: an operational permit granted by the Fisheries Conservation and Control Division, and an occupancy permit granted by the Malta Environmental and Planning Authority. Similarly, Algeria has an operating licence granted by the territorial authority in-charge of fishing and, if the activity involves the occupation of a public area, a public concession agreement. In accordance with the Decree of 21 November 2004, a commission is established to assess the granting of this concession. Various administrative authorities are represented in this commission: fisheries agency, public domain management, aquatic resources agency,

¹⁰ Policy 3.5: “Aquaculture Resource Management and Ecologically Sustainable Development Policy”, for South Australia, 12 August 2004, in application of the Aquaculture Act 2001.

agricultural services, tourism, transport and forest conservation authorities, environment agency and public works authority. A similar system is in place in Morocco: an operating licence (“Authorization of exploitation”) is granted by the Marine Fisheries Department and a temporary permit to occupy the public area is granted by the Ministry of Public Works.

Two forms of authorization are also required in Turkey: a fish farmer certificate granted by the Ministry of Agriculture and Rural Affairs (MARA) for a period of three years, and permission to occupy the maritime area or maritime space for the aquaculture facility, which is granted by the provincial authorities. This occupancy permit is the main permit for practising aquaculture in Turkey, and is it associated with important legal security an aspect which further complicates the aquaculture licence-granting procedures. For example, permits may be granted for three or even 15 years.

In short, besides the public bodies involved in the procedure, the concurrence of two main administrative authorities is required: one is responsible for the actual aquaculture activity and grants the licence to begin operations. The other manages the shoreline and public coastal areas and authorizes the occupation of a public area for a specified time. It is the granting of this second authorization that generates most problems.

Often these two main agencies belong to different departments or ministries which mean that they must liaise with each other in the interest of speeding up the process. This makes institutional coordination and cooperation all the more necessary. In this sense, a step forward has been made in Spain with the integration of responsibility for management of the coasts (public domain) and the bodies that represent Spanish marine aquaculture, through the creation of the Ministry of the Environment, Rural and Marine Affairs. However, power to authorize aquaculture operations remains in the hands of the autonomous regions (i.e. regional governments) which further complicate the system. This analysis of the current state of play shows that the main problems that tend to characterise aquaculture in practice are the lack of simplification in administrative procedures, the numerous authorities involved and the resulting over-bureaucratization and lengthy timescale of licence granting procedures.

Involvement of other administrative authorities

The procedure becomes even more complicated when additional permits, licences and reports are required from other authorities with responsibilities on the coastal and maritime areas. This is due to the fact that marine aquaculture activities are carried out in environmental sensitive areas; areas where numerous economic interests are usually at play. Consequently, the various authorities involved must issue an opinion regarding the location of new facilities to avoid negatively affecting the interests that they defend or represent. These agencies produce their assessment on the possible impact of aquaculture with regards to other activities such as navigation, the physical environment, tourism, fisheries, etc.

In Spain, the procedures vary from one autonomous region to the next, although in almost all of them, it is the authority responsible for aquaculture that receives the application and gathers all the reports from the authorities with coastal responsibilities: regional planning, defence, tourism, regional ministries of the environment, navigation, ports, culture and heritage, and local councils. Once all the reports have been obtained, the application is publicly announced and the corresponding EIA is requested from the environment agency. Finally, the application is forwarded to the national agency responsible for the public space, which then issues a binding report or the concession for the occupation of the public space. Generally, most common agencies involved are: fisheries; merchant shipping or navigation; environment; physical planning and public works; culture; national defence; health and welfare; industry; and local authorities.

In Turkey, the Ministry of Agriculture and Rural Affairs, with the involvement of other administrative authorities, grants the licence (tourism, navigation, health, the Ministry of Environment, and local and

provincial authorities). However, the use of maritime areas must be authorized by the provincial authority.

Application form and information required

Promoters who apply for a licence should provide the granting authority with a set of documents (in Spain “expediente”, in France “dossier”) containing information on the intended aquaculture activity.

The amount of information required and the degree of detail is different from country to country. Even some regulations for a specific aquaculture activity can be different from other types of aquaculture in the same country. In a general way, the commonly requested documentation required by administrations is the following:

Personal and professional information

The application must include the names and legal status of the applicant, professional skills and experience. This required documentation will be different depending on the type of applicant: individual or a legal entity.

Personal and legal status of applicant

Some countries may require conditions of citizenship to develop an aquaculture activity (e.g. Chile). The reason for such a citizenship condition is usually linked to the fact that aquaculture is developed in state-owned areas which are defined as public domain and were historically reserved for the use of nationals. Nevertheless, developed countries permit access to foreigners.

Many rules for aquaculture, limit the requirements to “residence” in the country. This is the case of the National Offshore Aquaculture Act in the United States of America (2007) which establishes that “an offshore aquaculture permit holder must be a resident of the United States of America” (Sec. 4.2), and of the Chilean Aquaculture Act which establishes that “only individuals of Chilean nationality or foreigners with permanent residence in the country and Chilean legal entities, established in accordance with Chilean law, may apply for aquaculture concessions or authorizations” (Art. 71, Fisheries and Aquaculture Act No. 18.892, 1989).

Professional qualifications

Professional qualification requirements are used to ensure the best development of marine culture and to guarantee that the public domain or public waters are used and occupied by professionals who intend to dedicate their licences to aquaculture activity and not to other purposes.¹¹

Spanish regulations require a “Director technical qualification and staff qualification” (Decree 406/1996 on Cage Aquaculture in Galicia). In Norway, the Aquaculture Act (2005) states that “any person who participates in the activities encompassed by this Act shall have the necessary professional skills to carry out such activities” and refers to other regulations that “the Ministry may prescribe, by regulations, detailed provisions relating to the professional competence requirements for activities encompassed by this Act” (Art. 22 “Professional competence”).

Technical information

This information should contain different aspects regarding technical issues of the aquaculture project in order to give as much information as possible to the lead agency in order issue or deny the licence:

¹¹ In Spain, when aquaculture started in the 1980s, many promoters applied for an aquaculture licence and finally they dedicated the concession to other purposes more profitable like sand exploitation, tourism, etc.

a) *Biological plan*. This document will describe:

- species produced
- method of culture
- production target
- production schedule

b) *Environmental plan*

- information required for environmental assessment
- mitigation measures
- possible damage to the environment

c) *Geographical information*

- A map of the requested area
- In the Canary Islands, more detailed documentation is required: bathymetry studies, cage layout map, anchor requirements for cages, etc. (Decree 182/2004, 21 December, approving the Canary Islands Fisheries Act).

Economic plan

This plan includes all aspects related to the economic life of the aquaculture project, including the following aspects:

- a) financial capacity of the aquaculture project
- b) economic and financial study: feasibility of the aquaculture project
- c) total cost of the facilities
- d) commercial plan

Allocation process methods

Depending on the legislation and type of aquaculture activity the licence granting process may be via a competitive allocation process or a single application process. When it is necessary, the public domain occupation and the allocation of authorization of sites are made by public tender or another competitive method (e.g. public tender, auction or ballot). That is the case of marine cage aquaculture in Spain (licensing by public tender) and New Zealand and Australia. In Norway, “the allocation of licences for farming of salmon and trout, which currently takes place through a traditional applicant competition, can be carried out in a less resource demanding manner pursuant to the Aquaculture Act (2005)”. Alternatively the qualification and subsequent selection of applicants can be carried out through drawing of lots for qualified applicants or through auctions.

The National Offshore Aquaculture Act of the United States of America requires a “single application” and not a competitive one. The applicant shall submit an application to the authority specifying “the proposed location and type of operation, the marine species to be propagated or reared, or both, at the offshore aquaculture facility, the construction and operational information, as specified by regulation”. In a competitive allocation system, the authority is in-charge of including all these conditions about species, locations, etc.

The South Australia Aquaculture Act (2001) establishes different ways to grant a licence depending on the location where the aquaculture activity is to be developed. So, a non-competitive allocation is reserved for aquaculture tenure outside aquaculture zones and prospective aquaculture zones. This allocation system is subject to “the ability of the applicant to meet business viability and environmental management criteria to the satisfaction of the Minister on advice from the Aquaculture Tenure Allocation Board”. Applications for aquaculture tenure in aquaculture zones will only be accepted in response to a call for expressions of interest, following the “competitive allocation” system. The selection of an applicant by the Minister is based on published selection criteria and advice from the Aquaculture Tenure Allocation Board. These criteria include:

- nature of the proposal
- economic benefit to the state
- technical capacity
- business capacity
- environmental management capacity
- other relevant criteria published by the Minister¹²

In Spain, many regional governments establish the competitive allocation system for marine cage culture: the Galician Fisheries Act (2008) provides that concessions will be granted following a public tender prevailed by objectivity, equity, publicity, competition and transparency principles. The set of criteria for applicant selection is published and includes the following:

- a) the applicant has been an aquaculture licence holder prior to the tender
- b) the applicant has previously developed marine aquaculture in cages
- c) the applicant has experience and skills in marine cage culture
- d) the applicant complies with the technical, sanitary and environmental criteria set forth in the public tender

The Canary Islands Fisheries Act (2003) also establishes the criteria for public tender in marine cage aquaculture, including the criteria for selection and evaluation:

- economic and technical viability of the project
- social profitability
- utilization of new technologies and the minimization of environmental impact
- the use of elements focusing on increasing the final quality of the products
- experience and skills in the aquaculture sector

During the licensing process, several requirements need to be assessed by the different administrations involved. This is the reason for the time-consuming process and the need for a strong coordination system among the authorities:

- environmental protection
- aquaculture activity conditions
- public health protection and food safety
- archaeological sites protection
- tourist activities
- military sites
- compatibility with other uses
- durability of licence

Duration of procedures, assessment reports from other authorities

The involvement of so many agencies and authorities results in lengthy procedures that may take between two and three years, as is the case of Greece, some autonomous regions in Spain and Turkey. The timeframe varies from six months to three years in Algeria, and can take up to four years in Egypt, where a particularly high number of administrative authorities are involved.

In Greece and some Spanish autonomous regions, the number of documents required and copies of those documents can exceed 8 copies for the Ministry of Fisheries and Agriculture, 3 copies for the

¹² Policy 5: “Aquaculture resource Management and Ecologically Sustainable Development Policy”, Gazetted on 12 August 2004.

Land Use Planning Office of the Ministry of the Environment, and a third application with 3 copies for the environmental impact assessment.

In Spain, the timeframe for aquaculture procedures varies depending on whether the facility occupies a public coastal area managed by the Directorate-General of Coasts of the Ministry of the Environment, Rural and Marine Affairs or a public port area managed by the Ministry of Development. In the first case, the duration of the procedure also depends on the autonomous regions, and ranges from 6 months to 2 years. In the case of aquaculture in port areas, the average timeframe is around 6 months.

Assessment reports

Notices and copies for the application and lead agency report are sent to numerous national and federal (if applicable) agencies including: navigation, tourism, environment, the local authority and other government agencies. The key elements in the aquaculture procedure are these assessment reports from other administrations involved in aquaculture licensing. These reports should support aquaculture activity. The goal of these reports is to assess the incidental impact of aquaculture by the authorities who are competent in different areas to aquaculture. The most important issue is coordination with the lead agency that is responsible for the final granting of aquaculture licences.

The lead agency who grants the concession should wait for this referral in order to award the final concession with permission from other administrations. Therefore these assessment reports must be sent in before the deadline set out by the licence procedure. At this stage, coordination among the different administrations is important in order to produce the report in a short period of time. The lead agency, usually the Ministry of Fisheries, is responsible to resolve any difficulties and to facilitate the progress of applications via coordinating committees of officials. The public administrative bodies which are involved in producing such reports in Greece, Spain and Norway are listed in Figure 5.

In some countries, for example in the United States of America, State of Maine, it is also necessary to take into consideration the noise or visual impact that aquaculture may cause. In these cases, the lead agency invites the competent authority to report on possible impact of such aquaculture development.

GREECE	SPAIN	NORWAY
<ul style="list-style-type: none"> – Ministry of Agriculture – Ministry of Mercantile Marine – Ministry of Finance – Ministry of Transportation and Telecommunications – Ministry of Defence – Ministry of Environmental, Physical Planning and Public Works – Ministry of Development – Ministry of Health and Common Welfare – Hellenic Navy General Service – Hellenic Tourism Organization – Organization of Agriculture Insurance – Local Authorities 	<ul style="list-style-type: none"> – Fisheries regional government – Ministry of Environment (Central Government) – Environment regional government – Tourism – Ministry of Defence – Navigation (Central Government) – Public works (Regional Government) – Heritage (Regional Government) – Local authorities 	<ul style="list-style-type: none"> – Regional Directorate of Fisheries – County Governor – Norwegian Food Safety Authority – Norwegian National Coastal Administration – Municipality – Norwegian water resources

Figure 5. Agencies involved in Greece, Spain and Norway

Environmental requirements

Environmental impact assessment

In general, applications for aquaculture projects are submitted with a technical study, biological study and other required documents such as the Environmental Impact Assessment. For aquaculture licences, the EIA is an important element for the supervision and protection of the environment where the aquaculture activity will take place.

Regulations within countries differ in terms of content and standards required for the EIA. The European Community rules have attempted to harmonize the legislation of the EU member states, the EIA requirements still differ from one country to the next. While in EU member states the EIA criteria are based on production, in other countries, for example Egypt, they are based on the area where the facility will be located.

Resolution: Final decision

Based on the reports or referrals mentioned above, the lead agency makes the final decision whether to grant or deny the licence. If the authority concludes that the aquaculture activities proposed for the site will not unreasonably interfere with other uses or will not result in an unreasonable impact on the environment and that the applicant fulfils the legal requirements, the lead agency awards the licence. The licence prescribing detailed provisions relating to its content, objectives, species, time limitations, rights and obligations that govern the use of the licensed area and impose limitations on aquaculture activities. Even if the licence is allocated without any special conditions, the aquaculture promoter must observe the provisions prescribed by the applicable laws and regulations.

In Norway it is the “the Ministry of Fisheries” who carries out the granting of the licence. In Spain it is the regional department responsible for fisheries and aquaculture. In Chile, the Ministry of Defence grants the concessions within 90 days. Applications in Greece are submitted to the Ministry of Environment, Physical Planning and Public Works. When all these authorities have made positive remarks, the local prefect gives permission for the establishment and operation of the farm.

A lead authority may prescribe bonds or escrow: In Maine (United States of America) the applicants shall post a bond or establish an escrow account pursuant to the regulation in the amount of USD 25 000 conditioned upon their performance of the obligations contained in the aquaculture licence and all applicable statutes and regulations.

All licence contents must be published along with the licence granted in an official Gazette in order to inform all stakeholders and particularly the new licence holder.

Duration, renewal of the authorization or concession

The permit for aquaculture in private zones is for an indefinite period while aquaculture in public waters has a limited period, but this may change from country to country. One of the most important elements of an aquaculture licence is its duration. The longer the duration of a licence, the more attractive it will be for aquaculture promoters. As marine cage culture is developed in public areas, managed by the states, the applicant needs the guarantee of a licence with a long duration in order to avoid the possible discretionary power of the public domain owner. This discretionary power could impose a shorter duration or revoke the licence if the land state owner considers that a more profitable activity may be developed in the area.

The financial cost of the facilities, the number of employees depending on the activity, and the need to recover the investment, make it absolutely necessary to provide a considerable length of time to the licence. The duration varies from country to country. Many establish a minimum licence duration, while others a maximum licence duration.

In Spain the common period for an aquaculture licence is up to 30 years. The Canary Islands Fisheries and Aquaculture Act (2007) provide a maximum of 30 years and, if the concession is granted for a lesser period of time, it can be renewed for different periods of time up to 30 years. In the Murcia Fisheries and Aquaculture Act (Spain) the minimum duration for the concession is up to 5 years: “concession is granted for a minimum period of 5 years, and this concession can be renewed up to a maximum period of 30 years” (Art. 84.5). Also in Spain, the Galician Fisheries Act 11/2008 states that: “concessions will be granted by a maximum period of 10 years, renewed for periods of 10 years up to a maximum of 30 years” (Art. 61). In the United States of America “the permit shall have duration of 20 years, renewable thereafter at the discretion of the Secretary in up to 20-year increments”.

Countries such as Chile and Norway establish an unlimited period of time for cage aquaculture permits. This unlimited time can be favourable to aquaculture promoters who will develop their activity with strong guarantees; however for public authorities managing coastal areas, this may lead to a lack of control over these areas.

Renewal of the authorization

A licence is usually renewable under the same conditions as the first one that was granted. This opportunity of renewal is necessary to make the aquaculture an attractive and economic activity and to guarantee that the licence holder has the possibility of continuing with this economic activity, thus maintaining both employees and market supply.

Obligations and rights

The legal framework for aquaculture in different countries contains common obligations and rights that allow us to draw some conclusions on the most frequent ones. Within the same rights some differences from one country to another may exist, or the obligations may be more or less restrictive.

Obligations

The obligations are usually reflected in the licence granted as provided by the law. Nevertheless, a licence holder must be informed of these obligations before the granting of the licence in order to have complete knowledge about the activity, i.e. constraints and limitations.

Lead authorities must supervise that the provisions prescribed and pursuant to the aquaculture regulations are observed. The most common obligations prescribed in the aquaculture regulations and contained in aquaculture licences are the following:

- a. an obligation to pay a fee, taxes and other payments. The fee is generally paid annually for the use of public waters (see below for additional information);
- b. an obligation to provide regular information regarding production;
- c. an obligation to start the exploitation or stop the activity within an agreed timeframe (e.g. Chile Norway and Spain);
- d. to mark aquaculture leases with floating devices such as buoys;
- e. to install and maintain all devices aiding navigation. In the Galician framework (Spain), when the cage is located in a polygon, public administrations are in-charge of installing and maintaining these devices while licence holders will cover their part of the expense. However, when cage culture facilities are not located in such polygons, the licence or concession holder will be in-charge of installing the devices and signs and will be responsible for all expense
- f. an obligation to maintain in a good condition the public domain or state-owned land;
- g. to establish mitigating measures for minimizing environmental damage;
- h. to sign an all-risk insurance (e.g. Murcia Law, Galician Law – Spain). This is important in order to prevent possible risks caused by navigation, storms, oil spills, etc.

Many aquaculture legal frameworks establish the obligation to register the licence with a register for aquaculture activities. This is the case of Chile, Norway, some autonomous regions in Spain, and some states in the United States of America.

Payment of fees and charges

Aquaculture licences are usually linked to the payment of a fee, either for the occupation of public space or for performing the actual aquaculture activity. Payment of the fee to occupy a public area is viewed as a pecuniary consideration that the state receives for the private or special use of public property.

On the other hand, the payment of charges and fees means that aquaculture will contribute to cover the costs regarding establishment, monitoring and inspection, environmental monitoring and water quality assessment, as well as any costs related to carrying capacity and the restoration of the public area to its original state, if necessary. These types of fees are usually paid annually and are calculated based on the criteria adopted by each country. Calculations attempt to combine criteria regarding surface area or volume of water occupied with criteria related to the annual production of the facility. Other regulations as in the State of Maine (United States of America) establish a fixed amount of USD 100 per acre per year.

An example of the calculation of occupation fees in accordance with clear and fair criteria is the negotiation initiated by the Spanish Association of Marine Aquaculture Operators (APROMAR) in 2004, with the Ministry of the Environment of the Spanish Government. The changes came about with the approval of Law 42/2007 on Natural Heritage and Biodiversity, which led to the setting of flat rate calculation criteria for all types of aquaculture, applying a single annual charge of 8 percent of the taxable amount comprising the value of the public land and a variable coefficient on the anticipated revenue generated from occupation of the public area. In addition, as a new feature intended to “encourage better environmental practices in the aquaculture sector”, this new Law provides for the fee to be reduced by 40 percent for concession holders that join the European Community Management and Audit Scheme (EMAS), and by 25 percent for those that become ISO 14001 certified. However, the situation is very different in other Mediterranean countries, such as Turkey, where the issue of calculating fees has yet to be resolved and where there are no standard rates or common criteria for their calculation. Current fees are very high.

According to the Norwegian Aquaculture Act, the Ministry may prescribe regulations relating to fees “for the processing of applications and the performance of supervisory work in accordance with the provisions in or pursuant to this Act. Any fees owed may be recovered by execution proceedings” (Paragraph 26). In any event, in order to ensure the legal security of the operator, the criteria used must be reasonable, transparent and uniform for each type of aquaculture.

Rights

Licences grant exclusive exploitation rights: the right to develop the aquaculture activity and to occupy a public area that cannot be violated by third parties or administrative authorities, who would have to indemnify the concession holder if they revoke the licences in question without a justified cause.

The aquaculture concessions or licences are usually transferable and may be covered by a mortgage, thus strengthening the legal and economic security of concessions.

The possibility of transferring the concession contributes to encourage promoters to invest in aquaculture, as it adds a commercial value to the licence. This value enhancement allows the concession holders to obtain more profit from the activity. However, authorities reserve the right to regulate such transfers by law and usually legal frameworks provide the possibility to transfer the

licence to other suitable parties following previous authorization from the authority who first granted the licence.

The Norwegian Aquaculture Act (2005) introduces, as an important innovation, the right to transfer and mortgage licences. For this law “deregulation of the ownership requirements in combination with the right to transfer and mortgage licences offers stability to the industry in relation to other industries and makes the industry more adaptable with respect to meeting future challenges”. The right to transfer and mortgage licences can contribute to greater predictability and improved access to capital for the industry.

The Norwegian Aquaculture Act also states that “the relevant sector authorities receive information on the change of ownership. Thus it is not a new licence that is issued; it is a continuation of the licence, including licences from other authorities. In reality, the current practice is not an opportunity to transfer; it is a reallocation of the licence at the holder’s request”.

Mortgage rights mean that licences can be used as collateral for a creditor’s security interest. The Norwegian Aquaculture Act indicates that “the introduction of the right to transfer aquaculture licences will result in an increased willingness to invest on the equity side from investors; the easier it is to sell an asset, the less the risk is to the investor”.

Spanish aquaculture laws usually introduce some conditions to authorizing such transfer. The Galician Fisheries Act (2008) allows the transfer prior to authorization by the regional government and the verification that the new aquaculture tenure complies with requirements provided by the law.

In Chile, the Fisheries and Aquaculture Act establishes that concessions can be transferred or leased with the prior permission of the Sub-secretariat of Fisheries and when the concession or authorization holder has been operating the farm for at least three consecutive years, or if six years have elapsed from the official delivery of the title (Art. 80).

Revocation and termination of aquaculture licences

If any conditions or requirements imposed on the licence or in the regulations are not observed, the lead agency may revoke an aquaculture licence. Common reasons for revoking a licence include:

- a. if the aquaculture activity damages the environment;
- b. in the event of gross or repeated contravention of the provisions prescribed in or pursuant to the Act (e.g. in the Norwegian Aquaculture Act, 2005);
- c. if the licence is not used or only used to a limited extent;
- d. discontinuing aquaculture activity for a year without a justified reason (e.g. Spanish laws);
- e. if a holder renounces the permit (e.g. Canary Islands law);
- f. failure to start aquaculture activities in the timeframe prescribed by the licence;
- g. for “public utility or the interest of society” reasons that entail the revocation of land use rights where aquaculture is developed. In this case, compensation payments are necessary (e.g. Galician Fisheries Act, 2008);
- h. if the licence is transferred without authorization from the public authorities (e.g. Galician Fisheries Act, 2008);
- i. leasing of the facility (Note: Chile permits the leasing of the facility);
- j. if using the aquaculture facility to perform illegal activities;
- k. when not submitting to the public administration the required statistical data;
- l. when the aquaculture activity does not reach the profitability threshold.

Chilean Fisheries and Aquaculture Act prescribes that the permit holder renounces (Art. 83) and states the lapsing of concessions (Art. 142) when the aquaculture site is exploited with a different objective or when the fees are not paid.

At the termination of a marine cage culture licence the permit holder is usually requested to remove all structures, gear, and other property from the site and take other measures to restore the site as prescribed by the authority.

RECOMMENDATIONS AND POSSIBLE PROCEDURE IMPROVEMENTS

Recommendations are presented below for establishing or modifying agency roles or responsibilities in order to provide a more effective framework for aquaculture authorization and concession granting in the RECOFI countries.

As outlined above each country has its own legislation and its specific aquaculture system. Therefore it is very difficult to summarize common rules or conclusions for the aquaculture legal system from different countries. Nevertheless, existing best practices in the different regulations can be highlighted and present general recommendations on the implementation of an aquaculture framework or for improving existing regulations.

It is commonly admitted that the complex procedure for applying for an aquaculture licence is the main barrier to investors. This lengthy, complex and time-consuming process is due to the intervention of many agencies that need to release separate assessment reports. It is, therefore, strongly recommended for all procedures to be well coordinated, along with the preparation of guidelines offering clear and detailed information on the aquaculture activity. A solid legislative support will also contribute to reducing the lengthy procedures for licence granting and administration overlapping. The proposed recommendations are the followed:

1. The aquaculture industry must have a suitable legal framework which includes all the conditions for its practise as well as guarantees of the rights and obligations of aquaculture licences holders. The lack of clear and concise regulations with the division of tasks between different administrative authorities may generate overlapping of areas of competence and delays in procedures.
2. The legal framework for aquaculture must establish the basic programmes and conditions for the establishment of suitable areas for aquaculture. It is impossible to take business decisions without a precise and transparent knowledge of the rules that will govern those decisions.
3. Aquaculture legislation must address the social and economic aspects of the area in which aquaculture activities are to be carried out, highlighting the strategic importance of aquaculture in the local economies. Moreover, it must provide mechanisms for the stakeholders' participation.
4. Administrative authorities with responsibilities in aquaculture that consider this activity as strategic should develop guidelines for the submission of applications, containing legal and institutional information.
5. The legislation regulating aquaculture must include a definition of the activity and a minimum content: its various farming system, the areas in which it may be carried out, plans or areas of interest for aquaculture and characteristics for the establishment of aquaculture facilities; the authorities competent for the development of aquaculture regulations, environmental protection criteria, EIA management systems, etc.; rights and duties, concession procedure; authorities involved and the mechanisms for the granting of permits, licences and granting systems; land use, registration of licences, transfer, inheritance, licence mortgages; control and sanction mechanisms; causes of revocation, expiry and cancellation; fees and charges.
6. Regulations must contain clear procedures for granting aquaculture licences and the necessary criteria for coordination between administrative authorities and agencies involved in such procedures.

- a. It is important to have regulations that clearly inform aquaculture operators of the requirements for obtaining a licence, the timeframe of the application process so that they have an idea of the timescale for the commencement of activities, as well as the rights and duties attached to the licence. It would be also useful for aquaculture operators to have a simple form with a checklist-style appendix listing the documents, maps, photos, etc. that are requested in the licence application form, to help the applicant ensure that all the documents are prepared and submitted.
 - b. The creation of “one-stop-shops” should be promoted, to centralize licence-granting procedures, thus reducing procedure timeframes and requirements. This would simplify the document submission process for aquaculture operators, saving them from having to go to the various agencies or administrative authorities competent in aquaculture, as all their reports and licences would be processed through a single coordinating or leading agency.
 - c. Instruments must be prepared to coordinate administrative procedures for the granting of the various authorisations. This will ensure the legal security of both the applicant and the granting authority itself, while also simplifying the processes for the granting of aquaculture licences.
7. The main body responsible for managing and coordinating the procedure must set the deadlines for information and responses from the other agencies or authorities that must issue opinions on different aspects: navigation, culture, heritage, ports, environmental, tourism, etc. Coordination policies should be developed through the setting up of inter-agency task groups.
 8. A preliminary public information period should be incorporated into the licence granting procedure. This will serve as an opportunity to adequately receive inputs from all other potential resource stakeholders regarding the proposed activity.
 9. Legislation must establish the validity period of licences. This will ensure the legal security of aquaculture and the durability of aquaculture businesses. In these cases, licences must be limited, although the validity period must still be sufficiently long to encourage operators to invest. The duration may range from 10 to 20 years, renewable for equal periods, with the administrative authorities establishing appropriate controls to ensure that operations are economically and ecologically sustainable. Moreover, a limit may be set on the maximum duration of licences and renewals
 10. The criteria used to calculate the aquaculture fee must be reasonable, transparent and uniform for each type of aquaculture, in order to ensure legal security. The fee for the occupation of public space must be proportional to the use thereof, and take into account the specific character of the aquaculture activity in question.
 11. The capabilities and human resources of the administrative authorities responsible for aquaculture should be increased, backed up by a political commitment to coordinate the institutions and agencies involved in the regulation and management of aquaculture.
 12. Coastal zone management and reserving zones for aquaculture may be a key in aquaculture procedures improvement. The applicant knows all the information and documentation requested for that specific space or site and if both – applicant and public administration – know previously that the site is suitable for developing aquaculture activities, licensing will be granted in a reasonable period of time. Application times could be significantly reduced if more proactive approaches to site designation were undertaken.

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THE LICENCE APPLICATION PROCESS OUTLINE

1. Application form

The applicant must prepare the application along with all the documents and information required by law. The rules may ask for several copies of the following documentation:

- personal identification
- certificate of professional qualification
- technical information on the project: proposed culture system, species information, estimated annual production, estimated starting date, production schedule, etc.
- geographical information: farm site maps, proposed layout of all facilities, etc.
- financial and economic plan: economic feasibility of the project, commercial plan, etc.

2. Submit application to the lead agency

The application form is submitted to the lead agency that can decide if to follow a simple or a public tender procedure. The lead agency decides whether or not the application is complete. If incomplete, the applicant will be asked to provide the missing information. If complete, the lead agency will forward the application to other regulatory agencies with competences in navigation, culture, tourism, heritage, etc.

3. Site review

In many cases, the lead authority set up a site review. For places that are no included into a coastal aquaculture zone.

4. EIA and other environmental assessments

Parallel to the application submitted, the promoter must prepare an environmental impact assessment or other environmental statements according to the legislation of the country. A number of environmental measurements will be made on the site. The environmental assessment report will be forwarded to the lead agency for evaluation.

5. Public hearing

The lead agency allows public participation in the aquaculture leasing process. Stakeholders and the public in general may consult the project and voice their opinion. Some countries, for example the United States of America, State of Maine, allow this public hearing through the Internet. Anyone can attend and speak at a public hearing.

6. Public notice

The responsible department will issue a public notice of the hearing.

7. Decision

The lead agency will prepare a report clearly recommending and justifying whether to grant or deny the lease.

A favourable decision will be published in the Official Gazettes in order to inform all stakeholders as well as the applicant clearly indicating what are the conditions of the lease.

The decision shall contain, among others, the following aspects referring to rights and duties of the licence holder:

- a. following the official notification, the new licence holder must establish a bond or a escrow account;
- b. the aquaculture licence holder should clearly mark the lease area with buoys or appropriate devices decided by the authorities;
- c. the decision must establish the exact amount of the annual fee to be paid by the licence holder;
- d. provide clear indications on the annual reports, statistical data, etc., to be submitted;
- e. duration of the licence. The decision must clearly specify the number of times the licence can be renewed after the initial issuance;
- f. information on licence transfer and conditions;
- g. registration condition into specific national registers;
- h. information on revocation and termination conditions of the licence;
- i. obligations regarding environmental monitoring;
- j. list of aquaculture laws and regulations including information on environmental rules, on protected areas, water quality, discharges, etc.

Type of data and information required and recommended prior to submitting a licence application for a fish cage farming site

The following is a short list of type of information that fish farmers should access before applying for a farm license for a specific site along the coast. The licensing procedure should also indicate what basic information is required to apply for a site.

Physical, biological and technical data

- site exposure and waves
- prevailing winds and storm occurrence
- oxygen concentration
- water depth
- prevailing currents and direction
- tidal regime
- temperature and salinity range and fluctuations
- water turbidity (water quality issues)
- occurrences of algae blooms
- type of cage to be employed
- mooring and anchoring systems

Potential impacts to the farm from:

- sewage outlets (from cities, villages, tourist complexes, etc.)
- industrial discharges
- presence of other fish farms (disease and parasite contamination issues)
- agricultural activities in the immediate surroundings
- presence of oil platforms and pipelines (oil spills contingency plan issues)
- potential erosion and sand drifts
- predators (seabirds, predatory fish, etc.)

Potential impact of the farm on:

- local communities and fishing villages
- fishing activities
- fish breeding and nursery grounds
- other fish farms (disease and parasite contamination issues)
- wild fish stocks (disease and parasite contamination issues)
- protected areas, animal sanctuaries and heritage sites
- mangrove swamps and sea grass beds
- coral reefs and other sensitive biotopes (lagoons)
- surrounding environment
- turtle nesting sites, marine mammals and other susceptible species
- tourist and leisure activities
- maritime transport and navigation
- naval and coastguard defence
- visual impact

Proposed cage aquaculture licence procedure

Documents required

1. Application form
2. Feasibility study
3. Environmental impact assessment study
4. Company registration documents

Application form

The application form should request the following minimum information:

- Information on the applicant (identification, qualification certificates, etc)
- Project overview
- Location or area of the proposed farming site (detailed maps required)
- Species to be cultured (information on fingerling source required)
- Targeted production

Application evaluation steps

1. Submit duly completed and documented application form to the competent authority (CA)
2. The application and site will be technically evaluated by CA
3. In case of no technical objection, the application will be forwarded to the other concerned agencies (it is recommended that an Aquaculture Committee is established to coordinate the evaluation and approval process of all authorities concerned)
4. In case of approval from the all agencies, the applicant will be granted a preliminary approval indicating licence conditions
5. The applicant shall submit the EIA and feasibility study to the CA
6. Review of the EIA and feasibility study by the CA
7. Final licence application approval or rejection

Criteria for preliminary approval of an application

- No negative impacts of the project on local fishing activities and communities
- No negative impacts on protected natural conservation areas, mangroves and coral reefs
- Acceptance of the applicant to the follow-up and inspection visits from the CA
- Financial position of the applicant or company
- Distance of the project from main maritime routes
- Use of permitted farming and construction material
- Compliance with all marine safety measures (use of warning signals and lights)

Information on a license document

- Company name and address
- Farm site location and area
- Farmed species
- Production outputs allowed
- Date of issue, duration and type of license
- Any other project-specific information required by the CA including monitoring obligations, payable and recurring fees and, revocation and termination conditions

General recommendations

- Periods for experimental and commercial projects should be clearly determined
- License renewal intervals should be determined
- Conditions for revocation or termination of license
- The licence application evaluation process should be defined

The technical committee and its specializations

The Technical Committee (TC) would comprise a representative from all concerned authorities and headed by the competent authority for aquaculture. The main duties of the TC would include:

- Reviewing aquaculture project applications submitted
- Determining the suitability of the proposed project site
- Submitting recommendations to the CA particularly with regards to project siting
- Reviewing the project documentation and providing appropriate recommendations
- Studying the obstacles faced by the aquaculture sector and propose appropriate solutions

Proposed fees

- Fees for issuance or renewal of a permit (commercial and experimental)
- Fees for land concessions
- Fees for permit transfer
- Fines for no compliance to regulations and licence conditions

Group photograph of workshop participants



The Regional Commission for Fisheries (RECOFI) Regional Technical Workshop on Sustainable Marine Cage Aquaculture Development, held from 25 to 26 January 2009 in Muscat, Sultanate of Oman, was organized in view of the growing importance and interest of this aquaculture sub-sector across the region. The workshop focus was on environmental impact assessment and monitoring, and aquaculture licensing for marine aquaculture cage systems. It also aimed at identifying constraints and shortcomings that need to be dealt with to support the development of the cage industry and facilitate investments from the private sector. The document contains a set of suggestions and recommendations with regard to technical and policy requirements needed to support the growth of the aquaculture sector as a whole and more specifically cage fish farming. The report also contains three review documents on marine cage aquaculture in the region, regulation of Norwegian net-cage fish farming, and a review on cage aquaculture licensing procedures prepared as background discussion papers for the workshop. With specific regard to environmental impact assessment (EIA), the discussions held at the workshop clearly indicate that there is a need for the region and individual Commission members to develop an ad hoc EIA format based on the conditions of the local marine environment. A proposed cage aquaculture licence procedure was discussed and proposed at the workshop based on the format developed and adopted by the Sultanate of Oman.

ISBN 978-92-5-106224-1 ISSN 2070-6987



TR/M/10723E/1/04.09/520