

**REGIONAL COMMISSION FOR FISHERIES**

**Report of the**

**FIFTH MEETING OF THE WORKING GROUP ON AQUACULTURE**

**Doha, the State of Qatar, 27 October 2010**



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## **PREPARATION OF THIS DOCUMENT**

This document is the final report of the fifth meeting of the Working Group on Aquaculture (WGA) of the Regional Commission for Fisheries (RECOFI) held on 27 October 2010 in Doha, Qatar.

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

## **ACKNOWLEDGEMENTS**

Many thanks are due to the Department of Fisheries Wealth, Ministry of Environment, the State of Qatar, particularly to the Department of Fisheries Wealth for the support and excellent hosting of the meeting.

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## ABSTRACT

The fifth meeting of the Working Group on Aquaculture (WGA) of the Regional Commission for Fisheries (RECOFI) was held in Doha, the State of Qatar, on 27 October 2010 and was attended by the representatives from seven Member countries. The WGA reviewed the outcome and recommendations of the Special Meeting on RECOFI Consolidation and Development held in Rome in May 2010 at the request of the Commission at its Fifth session. The WGA in acknowledging the suggestions made at this meeting, requested the Secretariat to communicate to its Members the options to be considered for strengthening the Commission, well in advance of its next session. The WGA discussed national and regional follow-up actions to the two WGA technical workshops on Aquatic Animal Health (Jeddah, Saudi Arabia, 6–10 April 2008) and on Sustainable Marine Cage Aquaculture Development (Muscat, Oman, 25–27 January 2009). In general, it was agreed that the Members benefitted from technical workshops organized under the *aegis* of the Commission. It was nevertheless noted that an efficient mechanism on how to best ensure a coordinated and region-wide response and follow-up to key technical recommendations was needed. A brief presentation on the joint RECOFI WGA and Working Group on Fisheries Management (WGFM) Regional Technical Workshop on Spatial Planning for Marine Capture Fisheries and Aquaculture, held in Doha, Qatar, from 24 to 28 October, was presented highlighting the key recommendations and suggested follow-up outputs. The meeting discussed the Regional Aquaculture Information System (RAIS) following the presentation of the first Web analysis report which indicated a steady interest in the information system particularly among the Arabic speaking countries. Actions to further consolidate the system were discussed along with the need to improve the overall communication outputs at the national and regional levels. The WGA finalized its proposed programme of work for the next intersessional period, based also on the recommendations from its previous technical workshops. The WGA recognized that the Commission, based on its current level of financial contribution, may not have the required budget to implement a comprehensive aquaculture programme and recommended that some activities could be implemented with extrabudgetary funds. The WGA Focal Point of Qatar was nominated as the new WGA Chairperson.

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## **OPENING OF THE MEETING**

1. In the absence of the outgoing Working Group on Aquaculture (WGA) Chairperson, the Fifth WGA meeting was opened by the WGA Technical Secretary, Mr Alessandro Lovatelli, Aquaculture Service (FIRA), Department of Fisheries and Aquaculture of the Food and Agriculture Organization of the United Nations (FAO). He noted that this annual meeting of the working group was organized in concurrence with the joint RECOFI WGA and Working Group on Fisheries Management (WGFM) technical workshop on Spatial Planning for Marine Capture Fisheries and aquaculture.

2. In his introductory remarks, Mr Lovatelli highlighted RECOFI activities that had taken place recently particularly with regards to the Special Meeting of the Commission which was held in Rome in May 2010 that discussed options on strengthening the Commission as a true management organization (see below for additional details). He invited the WGA to develop and propose a concrete work plan proposal for the next biennium regardless the current financial uncertainty of the Commission.

3. The meeting was attended by seven Members of the Commission. In the absence of the delegate from the Islamic Republic of Iran, the participant from the Iran Fisheries Organization attending the RECOFI Regional Technical Workshop on Spatial Planning for Marine Capture Fisheries and Aquaculture was invited by the Secretariat to attend the meeting as an observer. The list of delegates and observers to the meeting is attached in Appendix B.

## **ADOPTION OF THE AGENDA**

4. The Agenda of the meeting in document RECOFI:WGA/V/2010/1 was adopted without changes. The Agenda and the list of documents before the meeting appear in Appendix A and C, respectively.

## **REVIEW OF AQUACULTURE DEVELOPMENT**

5. The Secretariat informed the meeting that the National Aquaculture Sector Overviews (NASOs) for the RECOFI Member countries, with the exception of the Islamic Republic of Iran and Qatar, had been updated in collaboration with the WGA Focal Points and posted on the FAO and RAIS Web sites.

6. The delegates were further informed that the NASO updating process that commenced this year is part of a partnership consolidation process between FAO and its Member countries aimed at ensuring an efficient aquaculture information exchange to better monitor the status and trend of aquaculture at the national and regional levels. The WGA Focal Points discussed the importance of updated country reports and agreed to undertake NASO updating every two years prior to the biannual session of the Commission RECOFI session. The next updating will therefore take place before May 2012.

7. It was further agreed that a summary on the developmental status of aquaculture in the Region should be prepared and made available on the RAIS. The Secretariat pointed out that such a summary document was regularly produced for the RECOFI session. Once produced the RAIS Regional Centre would be requested to upload the document in its Web site.

8. The NASO documents for the eight RECOFI Members are enclosed, at the request of the delegates, in this document in Appendixes D to L.

9. A few delegates referred to the FAO regional aquaculture review for the Near East and Northern Africa presented at the Global Aquaculture Conference co-organized by FAO and held in Phuket, Thailand, from 22–25 September 2010. It was noted that the review presented did not adequately cover aquaculture development in the RECOFI region. The WGA Technical Secretary explained that the limited time allocated to the presentation was inadequate to comprehensively cover such a large and diverse region. In addition, he mentioned that the FAO consultant recruited to prepare the review had unfortunately received insufficient support from the RECOFI Focal Points in terms of updated and recent information on the sector.

## OUTCOME OF THE SPECIAL MEETING ON RECOFI CONSOLIDATION

10. The WGA Technical Secretary explained that the Special Meeting on RECOFI Consolidation and Development was organized at the request of the Fifth session of the Commission (Dubai, United Arab Emirates, 12–14 May 2009). The meeting was convened at FAO's headquarters in Rome, Italy, from 11 to 12 May 2010. The purpose of the Special Meeting was to consider ways and means to enhance RECOFI's role as an effective regional fisheries and aquaculture management organization. The WGA participants were informed that the Special Meeting revolved on the findings of a technical review prepared by an independent consultant.

11. The WGA was informed that the Special Meeting agreed to make three broad recommendations in relations to the Commission's future technical, institutional and financial needs. These recommendations are:

- **Technical:** It was agreed that RECOFI Members would review the meeting document “*Preliminary findings on the operations of the Regional Fisheries Commission*” in their countries and provide written comments on each of the eight points raised in the document to the Secretariat before 30 September 2010. The Secretariat would collate and analyse the responses to develop a paper and recommendations for consideration and decision at the Sixth session of the Commission in May 2011.
- **Institutional:** The meeting noted that RECOFI operated with a part-time Secretariat. This situation limited the scope and depth of the Commission's work. Members should consider whether the services provided by FAO at the current level were sufficient and adequate to meet the fisheries and aquaculture needs and challenges of the region. If this was not the case a decision concerning a permanent Secretariat would have to be faced as an option. Decisions relating to the Commission's structure and other institutional considerations were needed.
- **Financial:** Based on the information contained in the meeting document “*Financial and activity scenarios: present situation and future options*”, the meeting recognized that RECOFI's financial needs, including the level of Members' contributions, depended on the work programme agreed by the Commission. It was also recognized that the current annual contribution level (USD 5 000) was quite inadequate, particularly when the amount of arrears were taken into account. After having assessed and agreed on the Commission's technical and institutional requirements to address fisheries and aquaculture issues in the region, RECOFI should determine how the work programme would be funded. The Commission's core functions and activities should be covered at least by the contributions from the Member while other activities of a project nature could be funded by extra-budgetary funding.

12. While recognizing the challenge that the technical review poses to RECOFI Members, the Technical Secretary informed the WGA that the Secretariat would prepare an inclusive and consolidated paper for consideration by the Commission at its next session in May 2011. At this session, the Commission will hopefully take a decision to place RECOFI, its working groups and its work programme on a more solid footing. This paper would fully reflect the outcomes of the technical review and the responses by Members to a questionnaire that had been dispatched by the Secretariat in August 2010.

13. Following the presentation, the WGA agreed that the consolidation and strengthening of the Commission was of extreme importance, particularly in relation to ensuring that it had adequate financial resources and commitment to undertake its programme of work. It was further recognized that, should the current level of Members' contributions remain unchanged, this would have a significant impact on RECOFI's work.

14. With respect to the outcome of the technical performance review and the survey questionnaire that had been dispatched in August 2010, the WGA requested the Secretariat to communicate to its Members the options to be considered for strengthening the Commission well in advance of the next session of RECOFI. Furthermore, some delegates indicated that it would be instructive to learn from the experiences of other, longer-established regional fisheries management organizations (RFMO) (e.g. the General Fisheries Commission for the Mediterranean), as to how they had taken steps to strengthen their roles and performance.

## **REVIEW ON COUNTRY FOLLOW-UP ACTIVITIES**

15. The WGA delegates presented brief reports on the deliberations and follow-up at the national level of the outputs from two previous RECOFI-WGA technical workshops, i.e. the Regional Technical Workshop on Aquatic Animal Health (Jeddah, Saudi Arabia, 6–10 April 2008) and the Regional Workshop on Sustainable Marine Cage Aquaculture Development (Muscat, Oman, 25–27 January 2009).

16. In general, it was agreed that the individual Members benefitted from technical workshops organized under the *aegis* of the Commission by providing an excellent forum to discuss issues of regional concern and interest. It was nevertheless noted, that the Members still needed to find out ways and mechanisms on how to best ensure a coordinated and region-wide response and follow-up to key technical recommendations.

### **Aquatic animal health**

17. It was noted that the WGA Technical Workshop on Aquatic Animal Health provided a road map for the development of both national and regional aquatic animal health programmes and strategies. It was however recognized, that much needs to be implemented at both the national and regional levels, including the development of regional standards for imports/movements of non endemic aquatic species, before such strategies were developed.

18. The WGA delegates briefly reported on relevant aquatic animal health issues that took place in their countries following the RECOFI workshop.

Bahrain	<ul style="list-style-type: none"> <li>- Reported that the Veterinary Department (Ministry of Health) is the authority in charge of animal health issues. Currently, it deals exclusively with live ornamental fish. The Aquaculture Centre is responsible for issuing health certification for fingerlings it produces. Internal reorganization may be required to ensure that aquatic animal health issues are coordinated at the national level.</li> </ul>
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Iran IR	<ul style="list-style-type: none"> <li>- The observer simply informed the WGA that the Veterinary Organization is an independent institution dealing with animal health issues including aquatic animals.</li> </ul>
Kuwait	<ul style="list-style-type: none"> <li>- No follow-up actions were reported following the RECOFI WGA workshop on aquatic animal health.</li> </ul>
Oman	<ul style="list-style-type: none"> <li>- Reported that the Ministry of Agriculture is responsible for animal disease issues including those on aquatic organisms. The Ministry of Fisheries Wealth operates an aquaculture pathology laboratory fitted with a wet and dry lab and a quarantine facility. Recently, two pathologists (one local and one foreign expert) have been recruited to record local fish pathogens. Following the RECOFI workshop and with the guidance of the technical report thereafter generated, a fish disease project had been submitted to the National Research Council as a first step towards developing a national aquatic animal health strategy.</li> <li>- Furthermore, reported that the Ministry of Fisheries Wealth recently signed an agreement with the University of Stirling (United Kingdom) to strengthen collaboration on fish disease matters.</li> </ul>
Qatar	<ul style="list-style-type: none"> <li>- Reported that the RECOFI workshop report had been officially submitted to the authorities. Follow-up has been slow as currently there is no commercial aquaculture activity in the country. The authorities nevertheless acknowledge the need to draft and eventually adopt an aquatic animal health strategy.</li> </ul>
Saudi Arabia	<ul style="list-style-type: none"> <li>- Reported that a new fish disease laboratory was open in the premises of the Fish Farming Centre in Jeddah. The laboratory carries out analysis on water, sediments and on fish. It is also responsible for issuing health certifications for farmed products.</li> </ul>
UAE	<ul style="list-style-type: none"> <li>- Reported that a new fish disease laboratory was open in September 2010 at the Marine Environment Research Centre and run by an Egyptian veterinary expert. The laboratory will be looking at fish disease issues and develop precautionary plans for fish imports and fish movements.</li> <li>- The Centre recently hosted a technical workshop on fish disease organized by the Office International des Epizooties (OIE) which was attended by its focal points across the region.</li> </ul>

### **Sustainable marine cage aquaculture**

19. The WGA delegates briefly reported on relevant cage aquaculture developmental issues that took place in their countries following the RECOFI workshop.

Bahrain	<ul style="list-style-type: none"> <li>- Reported that the RECOFI marine cage aquaculture report has been used to draft national licensing and environmental impact assessment (EIA) procedures, even though there are no commercial aquaculture projects in operation.</li> <li>- Reported that there are limited sites suitable for cage aquaculture mainly along the eastern coast where the water depth is reasonable. A new survey on potential sites is currently underway.</li> <li>- There is considerable interest in marine aquaculture development among investors which, due to the limited availability of natural resources in the country, are increasingly investing abroad.</li> </ul>
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Iran IR	<ul style="list-style-type: none"> <li>- The observer reported that there is an increasing interest in farming cobia and groupers in marine cages.</li> </ul>
Kuwait	<ul style="list-style-type: none"> <li>- Reported that the authorities are continuing their search for suitable sites for mariculture development along the southern coast of the country.</li> </ul>
Oman	<ul style="list-style-type: none"> <li>- Reported that the RECOFI technical report was most useful in tackling issues on coastal cage aquaculture development. An geographical atlas on the potential site for development of aquaculture in Oman was recently finalized, as well as, new rules on site selection identification issued. Harmful Algal Blooms (HABs) remains an issue discouraging companies to invest in fish farming.</li> <li>- The completion of the Oman Aquaculture Centre in January 2011 will stimulate activities in support of aquaculture development and provide a follow-up mechanism on recommendations resulting from RECOFI WGA technical activities.</li> </ul>
Qatar	<ul style="list-style-type: none"> <li>- Reported that a demonstration state-run project on cage aquaculture will be launched in 2011 on the southern coast using the exotic Gilthead seabream and European seabass.</li> <li>- Qatar recently reviewed a by-law proposal on aquaculture licensing and site selection circulated by the Gulf Cooperation Council (GCC) which aims at standardizing such regulations throughout the region.</li> </ul>
Saudi Arabia	<ul style="list-style-type: none"> <li>- Reported that marine finfish cage culture has started along the northern coast of the Red Sea. The authorities, with the support of the Fish Farming Centre in Jeddah, and outputs from the RECOFI WGA workshop are strengthening licensing, site selection and environmental monitoring procedures.</li> </ul>
UAE	<ul style="list-style-type: none"> <li>- Reported that the authorities are currently identifying sites suitable for cage aquaculture and planning to establish an early warning system for HABs along its coastline.</li> <li>- Reported also that an agreement was recently signed with a new company (Mubarak Fisheries) for the production of 700 000 fingerlings of gilthead seabream (also for export to Saudi Arabia). The company currently operates 10 cages which have been stocked with fingerlings of &gt;10 cm. Prior to the allocation of the farm site the company carried out a thorough environmental impact assessment.</li> <li>- Reported that the Marine Environment Research Centre is also mandated to research and produce fingerlings of local commercial species for restocking programmes.</li> </ul>

## OUTCOME OF THE RECOFI WORKSHOP ON SPATIAL PLANNING

20. The joint WGA and WGFM Regional Technical Workshop on Spatial Planning for Marine Capture Fisheries and Aquaculture, held in Doha, Qatar, from 24 to 28 October 2010, was implemented in response to a recommendation of the Fifth session of the Commission (Dubai, United Arab Emirates, 12–14 May 2009) and the Fourth WGA meeting (Muscat, Sultanate of Oman, 27–28 January 2009).

21. The recommendation proposed to review the regional competence in the use of spatial planning tools (e.g. Geographic Information System [GIS], remote sensing and mapping) 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 in aquaculture zoning.

22. Hosted by the Department of Fisheries Wealth, Ministry of Environment, Qatar, 21 delegates participated at the workshop, representing official participants and observers from seven RECOFI Member countries (Bahrain, the Islamic Republic of Iran, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates), representatives from FAO/Rome, two international consultants on marine capture fisheries and aquaculture, respectively, and one national consultant on GIS from Oman.

23. The significant outcomes of this regional technical workshop were:

- Awareness and capacity building on Spatial Planning for Marine Capture Fisheries and Aquaculture – a significant activity was presented by the Secretariat to provide participants acquired knowledge on the use of spatial planning tools to support the ecosystem approach to aquaculture and fisheries, case studies to show case experiences to address different issues such as (i) a study to assess the potential for off-the-coast and offshore mariculture, and (ii) a habitat atlas for Marine Resource Management (CHARM) to assess the status of benthic invertebrate fauna and key commercial fish species of the Eastern English Channel. A special presentation from the private sector provided an insight into the data and spatial analysis skills available among RECOFI countries that could be applied to fisheries and aquaculture.
- RECOFI Regional Spatial Planning for Marine Capture Fisheries and Aquaculture Questionnaire Survey Analysis Report – eight RECOFI Member countries fully cooperated in the completion of a subject-related questionnaire which was presented and further discussed during the workshop and served as a basis for the development of a regional strategy for implementing Spatial Planning for Marine Capture Fisheries and Aquaculture.
- Proposal for a Regional Strategy for Implementing Spatial Planning for Marine Capture Fisheries and Aquaculture in RECOFI Member countries – presented and further developed during the regional workshop based on the outcomes of the questionnaire survey, country presentations and the working group discussions. The draft strategy outlines a short-, medium- and long-term agreed-upon plan of activities to implement Spatial Planning for Marine Capture Fisheries and Aquaculture in the RECOFI Member countries and identifies activities of regional interest and importance.
- Interim activities identified with agency responsibilities prior to the next RECOFI session scheduled for May 2011.

24. The workshop benefitted from the participation of delegates from the RECOFI WGA and the WGFM to better address many issues that are common for spatial planning (e.g. data, models, training, experience) strongly suggesting that synergies must be strengthened for the future implementation of the proposed regional strategy.

25. The workshop noted that a core component of the regional strategy will be the identification of appropriate government agencies willing to cooperate in developing regional marine spatial plans. Furthermore, RECOFI Members will need to address issues related to governance with regards to adoption of the proposed regional strategy recommendations

including the acceptance of marine spatial planning, fishery zoning and the adoption of ecosystem approaches to aquaculture and fisheries management.

## **REGIONAL AQUACULTURE INFORMATION SYSTEM (RAIS)**

### **RAIS Web analysis**

26. The WGA Focal Point of Kuwait, Mr Soud Abdel Aziz Hussain, presented the RAIS Web analysis report elaborated by the RAIS Regional Centre in Kuwait. The values provided in the report were interpreted and discussed at the meeting. As of 16 October 2010 the total number of visits were 7 908 (Absolute Unique Visitors) from 154 countries. The number of pages viewed were 47 537 with an average time spent on the Web site of 3:09 minutes (see Appendix M for additional details). The data indicated that the experts database was the most visited. Furthermore, it was noted with satisfaction that numerous and relevant international web sites had established a link to the RAIS home page.

27. The analysis further indicated a steady interest in the RAIS, particularly following the Fourth WGA meeting (Muscat, Sultanate of Oman, 27–28 January 2009) with Web site visits and follow-up communications mainly from Arabic speaking countries (Northern Africa and the Gulf Region). This trend clearly demonstrates the importance on regularly promoting the information system along with the timely updating of its contents in order to further attract and retain the maximum number of visitors.

28. The delegates concurred that this analysis represented a useful tool for better optimizing the RAIS Web pages usage. It was hence agreed, that the RAIS Regional Centre should produce a Web analysis report every six months for circulation among the WGA Focal Points. It was further agreed, that the Secretariat along with the Head of the Information Technology Section of the Iran Fisheries Organization, would lend assistance to the RAIS Regional Centre to elaborate a standard reporting template with information on how to interpret the Web data and a glossary of technical terms.

### **Implementation of the RAIS communication strategy**

29. The Secretariat highlighted the necessity to regularly and effectively promote RAIS at the national and regional levels. It was noted, that insufficient promotion actions had been taken since the last WGA meeting. The limited and new information regularly uploaded on the system further indicated that the information system has not been effectively used by the public sector as a vector in providing the services for which it was originally conceived.

30. The meeting participants agreed that additional efforts should be done to better promote the system at the national level and during important aquaculture global events. The Secretariat recalled that the “Regional Aquaculture Information System Communication Strategy” (see Appendix G in the report of the Fourth WGA meeting) provides the agreed road map to promote the system. Furthermore, the WGA Focal Points were invited to make better use of the promotional material so far produced, particularly the flyers and press releases. It was also recalled that the RAIS user manual should be used and properly distributed to expand the number of RAIS authorized users to enter data into the system.

31. The participants noted that the RAIS Regional Centre in Kuwait has a vital role to play in the functioning of the information system with an important coordination responsibility in collating and verifying the data provided by the WGA Focal Points, as well as, in stimulating data submission from external authorized users. The other main function of the Centre include (i) data analysis and preparation of regional reports on the status and trend

of aquaculture in the Region; (ii) maintenance and upgrading of the Web site according to requests from the Members; (iii) liaising with FAO, the RECOFI Secretariat and the National RAIS Centres; (iv) promoting RAIS to potential users; (v) preparation of annual activity and progress reports for the WGA; (vi) draft annual work programme and budget for RAIS in coordination with the National Focal Points and the WGA Chairperson; and solicit external funding particularly from the private sector for the strengthening of RAIS.

32. The WGA delegates strongly invited the RAIS Regional Centre to ensure that its coordinating services are guaranteed and that adequate technical and IT staff are involved.

33. The WGA Focal Point of Kuwait ensured that he would relay the main concerns reported at the meeting to the Public Authority of Agriculture Affairs and Fish Resources (PAAFR) as the hosting institution of the RAIS. He further indicated, as a commitment of Kuwait in hosting and operating the RAIS Regional Centre, that all efforts will be made to better organize the staff allocated in the maintenance and functionality of the information system.

### **National RAIS data collection and submission**

34. The delegates noted the critical importance in the timely and regular collection of national data and information from different sources to feed into the system. It was further recognized that poor data inputs, including news items, along with a limited promotion of RAIS had occurred since the last WGA meeting. The critical role of the WGA Focal Points in feeding the system directly and/or through authorized users was once again emphasized.

35. The delegates agreed that the RAIS data entry modules and the bilingual RAIS User Manual (Arabic and English) were user-friendly and no particular problems have been met over the past year in the online data and information submission process.

36. During the discussion on the information system a number of improvements were proposed in order to better respond to national and regional needs. In particular, it was suggested to add a subject category list in the virtual library to facilitate the search of electronic documents. In this regards, the delegate from Bahrain informed that they are in the process of preparing PDF files for important national aquaculture reports for imminent uploading on the RAIS virtual library. The Secretariat took note of the comments received and confirmed that action, in this regard, would be taken. It was however noted, that such architecture improvements of the information system should be directly proposed and eventually handled by the RAIS Regional Centre.

37. It was also agreed that the RAIS should be used as a platform to disseminate the main outputs generated by the RECOFI WGA (e.g. technical workshops, training). In this respect, and with specific reference to the recent technical workshop on “Spatial Planning for Marine Capture Fisheries and Aquaculture” (Doha, Qatar, 24–28 October 2010) it was recommended to create dedicated RAIS pages to host regional GIS-related information. It was agreed however, to first utilize the existing databases by storing this information in the virtual library (reorganized by category) and in the news and events sections.

38. The Secretariat informed on the importance of upgrading the current version of Typo3 (the open source content management system – version 4.1) used for the development of RAIS to the updated and available version 4.4. The migration to the newest version would allow the development of a more structured architecture with the use of the new tools and functionalities available. The meeting acknowledged the recommendation and the WGA delegate from Kuwait requested FAO to provide the necessary technical assistance in the

upgrading. The Secretariat noted that the Commission had allocated a small budget for the development and consolidation of RAIS for the current biennium which had yet to be utilized.

## **PROGRAMME OF WORK AND BUDGET FOR THE BIENNIUM 05/2011–05/2013**

39. The WGA delegates discussed its programme of work for the next intersessional period taking into account the recommendations made at the joint WGA/WGFM workshop on Spatial Planning for Marine Capture Fisheries and Aquaculture and the activities which had already been proposed and endorsed by the Commission at its Fifth session (Dubai, United Arab Emirates, 12–14 May 2009), but which had not been implemented due to budgetary constraints. The WGA agreed that the activities discussed and prioritized at its Fourth meeting (Muscat, Sultanate of Oman, 27–28 January 2009) remained important action priorities in support of a sustainable development of the aquaculture sector at the regional level.

### ***Capacity building for spatial planning and management (Priority Activity No. 1)***

40. A survey questionnaire completed by the eight RECOFI Member countries during June-July 2010 and the feedback received at the joint RECOFI WGA/WGFM workshop on Spatial Planning for Marine Capture Fisheries and Aquaculture (Doha, Qatar, 24–28 October 2010) revealed that basic and/or advanced training is one of the core needs amongst Member countries. Therefore, one of the main components of the proposed regional strategy for Marine Capture Fisheries and Aquaculture in RECOFI Member countries is specific to capacity building for spatial planning and management.

41. Following the marine spatial planning workshop, the WGA acknowledged the need to conduct a training activity/workshop on the importance and use of spatial tools for decision-makers and for relevant technicians. The group acknowledged that Qatar could lead this effort if the activity is endorsed at the next RECOFI session and funding was made available.

42. In any aspect of fisheries and aquaculture, spatial location is a key factor and spatial tools allows spatial patterns to be interpreted with great facility. Training is important for decision-makers and technicians to fully appreciate the benefits and limitations of these tools. RECOFI Members will require training for decision-makers to increase their awareness and understanding of the benefits that such tools can provide and technical people will require hands-on training for data management, analysis, modelling and decision-making.

### ***Application of risk analysis to aquaculture (Priority Activity No. 2)***

43. During the WGA Regional technical workshop on aquatic animal health (Jeddah, Saudi Arabia, 6–10 April 2008) the application of risk analysis to aquaculture was recognized as an important tool in decision making and hence, proposed as a priority training activity. This activity was approved as part of the Commission's WGA work plan for the biennium 2009–2010, but was not carried out due to the lack of funds.

44. The activity proposed is therefore, the organization of a training workshop on the introduction of risk analysis as applied to the aquaculture sector. This introductory course would consist of lectures on the principles of risk analysis process, its application to the risk sectors affecting aquaculture, and group exercise using pathogen risk analysis as a model in the application of the risk analysis process to aquaculture.

***Environmental monitoring in cage aquaculture (Priority Activity No. 3)***

45. During the WGA Regional technical workshop on sustainable marine cage aquaculture development (Muscat, Oman, 25–26 January 2009) one priority activity identified concerned the development of a specific fish cage culture monitoring programme for the region. It was suggested that existing monitoring programmes in countries with a fish farming industry could be used, however, recognized that these would need to be adapted to local environmental conditions. Furthermore, the importance of monitoring results against environmental specific threshold impact limits (Environmental Quality Standards [EQS]) was emphasized by the group.

46. This activity was also approved as part of the Commission's WGA work plan for the biennium 2009-2010 but was not carried out due to the lack of funds. The WGA agreed that the activity proposed would consist of a short hands-on training activity abroad that would ensure quick and effective transfer of expertise that would allow the trainees, possibly in close collaboration with the training partner institution, to adopt the monitoring programmes and EQS to local conditions.

***Development of a national strategy on aquatic animal health (Priority Activity No. 4)***

47. At the WGA aquatic animal health workshop (Jeddah, Saudi Arabia, 6–10 April 2008) it was agreed that national and international aquatic animal health programmes are becoming essential to ensure the sustainable development of aquaculture and protect existing capture fisheries, aquaculture and aquatic biodiversity from negative impacts of exotic pathogens and diseases. Such national strategy provides a country with a road map, using the concept of phased implementation based on national needs and priorities to achieve the desired aquatic animal health status.

48. The WGA concurred that the organization of a planning workshop would assist RECOFI Members in the elaboration of the essential elements of a “National Strategy on Aquatic Animal Health” (i.e. policy, legislation and enforcement; risk analysis; pathogen lists; information systems; health certification; quarantine; disease surveillance; monitoring and reporting; zoning; emergency preparedness; research; institutional structure; human resources development; regional and international cooperation; and including farm-level health management) and the steps required in its development and implementation.

49. The importance of this activity was endorsed by the Commission at its Fifth session (Dubai, United Arab Emirates, 12–14 May 2009), but the activity was postponed and not included in the work plan of the WGA due to other priority activities and availability of funds.

***Aquaculture recirculation technologies (Priority Activity No. 5)***

50. The WGA delegates strongly felt that there is a need to introduce alternative fish farming technologies in the region such as recirculation systems (including aquaponics) in view of the prevailing geographical conditions and limitations, particularly in some of the countries, of specific natural resources.

51. The WGA supported the organization of a technical workshop on recirculation systems by inviting experts from commercial companies that provide such technology. Independent experts that may provide an economic insight on such farming systems should also be invited. The WGA once again suggested to replicate and/or adapt the format of an advance course on recirculation technology and systems organized in 2008 by the

International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) through the Mediterranean Agronomic Institute of Zaragoza (Instituto Agronómico Mediterráneo de Zaragoza – IAMZ) in Spain.

52. The importance of this activity was also endorsed by the Commission at its Fifth session (Dubai, United Arab Emirates, 12–14 May 2009), but the activity was postponed and not included in the biennium work plan of the WGA due to other priority activities and limitation of funds.

#### ***Climate change challenges in aquaculture development (Priority Activity No. 6)***

53. The WGA noted that climate change issues may be partly responsible for an increase incidence of harmful algal blooms in the Region. The delegates felt that the local aquaculture industry could expand faster particularly, if more reliable predictions are available on projected climate changes. The organization of a regional awareness workshop on climate changes could possibly be organized in collaboration with the WGFM.

Priority	Activity	RECOFI Working Group/s	Location	Duration (days)	Indicative budget <sup>(2)</sup> (in USD)
1	Capacity building for spatial planning and management (Training)	WGA/WGFM	Qatar	4–5	40 000
2	Risk analysis to aquaculture (Training)	WGA	Oman	3–4	35 000
3	Environmental monitoring in cage aquaculture (Training)	WGA	Outside RECOFI Region	10–14	25 000
4	Development of a national strategy on aquatic animal health (Planning workshop)	WGA	TBD <sup>(1)</sup>	3–4	35 000
5	Aquaculture recirculation technologies (Technical workshop)	WGA	TBD	2–3	25 000
6	Climate change challenges in aquaculture development (Awareness workshop)	WGA/WGFM	TBD	2–3	20 000

(1) TBD = To Be Determined

(2) Includes expenses such as the recruitment and travel of international and national consultants, commissioning of technical reports, printing and distribution of reports and Secretariat expenses.

## **Advancement of the Regional Aquaculture Information System (RAIS)**

54. The WGA noted and agreed that a limited budget allocation should be again reserved to further strengthening the information system and to provide technical support to the RAIS Regional Centre in Kuwait. Such funds would enable the WGA to implement specific tasks discussed and identified at the meeting including the establishment of new databases, upgrading of the RAIS software version and support promotional actions.

55. Following the outcomes and recommendations from the RECOFI WGA-WGFM Technical Workshop on Spatial Planning for Marine Capture Fisheries and Aquaculture (Doha, Qatar, 24–28 October 2010), the WGA delegates agreed that the two additional activities indicated in the table below should be included in the tentative work plan and budget of the working group for the next biennium as part of the RAIS consolidation and strengthening activities.

Activity	Notes	Indicative budget (in USD)
Regional Aquaculture Information System (RAIS)	- Development and consolidation	5 000
Aquaculture inventory and zoning	- Creation of National Aquaculture Sector Overview (NASO) maps to inventory and monitor aquaculture. - A similar effort could be made to create an inventory of landing sites for artisanal fish catches.	RECOFI/FAO-FI
Access to spatial data and information	- Use of RAIS Web site as a platform to disseminate spatial data and information. - Collection of specific and targeted datasets.	5 000

## **ELECTION OF WGA CHAIRPERSON**

### **Election of Chairperson and Vice-Chairperson**

56. The election of a new Chairperson of the WGA was necessary in view of the transfer and change of work responsibilities of the current Chairperson, Mr Dawood Suleiman Al-Yahai, from the Sultanate of Oman from the Ministry of Fisheries Wealth to the Ministry of Manpower. The delegates took the opportunity to acknowledge the excellent work carried out by the departing Chairperson, particularly with regards to encouraging an open and constructive dialogue among the RECOFI Member countries on aquaculture issues of regional concern.

57. The WGA proposed and unanimously nominated the Focal Point of Qatar, Mr Mohammad Falamarzi, as the new WGA Chairperson. The meeting participants further proposed and nominated *in absentia* the WGA Focal Points of the Islamic Republic of Iran and United Arab Emirates as the first and second Vice-Chairpersons, respectively. It was

agreed that the Secretariat would contact and inform the two Focal Points. The WGA furthermore suggested and agreed that at the end of the current Chairperson's term the first Vice-Chairperson would automatically take up such position and responsibilities.

58. The WGA Technical Secretary congratulated the new nominations and strongly emphasized the responsibilities and key role of the Chairperson in liaising between the Secretariat and all of the RECOFI and WGA Focal Points. It was recalled that the WGA terms of reference adopted by the Commission at its Fourth session (Jeddah, Kingdom of Saudi Arabia, 7–9 May 2007) appeared in Annex 3 of the report of the Second WGA meeting (Muscat, Oman, 29–30 November 2005). It was also noted that the Commission agreed on the terms of reference for the RECOFI National Focal Points at its Fifth session (Dubai, United Arab Emirates, 12–14 May 2009). These terms of reference appear in Appendix G of the session report.

### **Confirmation of WGA Focal Points and Alternate Focal Points**

59. The list of the WGA Focal Points (FP) and Alternate Focal Points (AFP) was reviewed and updated following the transfer of several nominees to other postings. It was noted that most countries had officially nominated both the FP and the AFP. The Focal Point of Kuwait agreed that he would provide to the Secretariat the name and contact details of the AFP at the soonest possible, while the observer from the Islamic Republic of Iran would request the authorities in Tehran to confirm the nominations of its two WGA representatives. The updated name list of the WGA FPs and AFPs, including their addresses and contact details, is attached to this report as Appendix N.

### **ANY OTHER MATTER**

60. The Secretariat informed participants on the outcome of an FAO technical workshop on "Aquaculture development in the desert and arid lands" held in Hermosillo, Mexico, from 6 to 9 July 2010. It was recognized that the results of this workshop would be of interest to the RECOFI countries considering the vast arid environment in the Region. FAO is in the process of finalizing the report, which will contain a strategy paper based on the workshop discussions and recommendations. This document will serve FAO Member countries to identify actions that will assist in strengthening this important aquaculture sub-sector. It was agreed that copies of the document would be distributed widely in the Region once available.

61. The Secretariat informed the WGA delegates of the new Eurofish ([www.eurofish.dk](http://www.eurofish.dk)) and FAO's joint publication entitled "*A guide to recirculation aquaculture – an introduction to the new environmentally friendly and highly productive closed fish farming systems*" of interest to the Region. Copies of this publication were made available and distributed.

62. The WGA delegates suggested that the RECOFI Secretariat should seek opportunities for experts in the Region to attend, as observers, relevant technical meetings and workshops organized by other regional fisheries management organizations. Specific reference was made to the General Fisheries Commission for the Mediterranean (GFCM). The Secretariat will follow-up the request particularly with the Technical Secretary of the GFCM Committee on Aquaculture.

### **DATE AND PLACE OF THE SIXTH MEETING**

63. The observer from Islamic Republic of Iran attending the meeting informed the participants that he had been authorized by the Iran Fisheries Organization (Shilat) to propose for the next WGA annual meeting to be held in the Islamic Republic of Iran in October-

November 2011. The meeting would be held in a suitable locality in the south of the country in order to allow the participants to visit selected commercial coastal and marine aquaculture operations and research/training facilities during a proposed one-day field visit.

64. It was once more noted that all regular WGA meetings should be attended by at least the WGA Focal Point or Alternate Focal Point, or both, to ensure continuity in the discussions and national reporting. Furthermore, the possibility of organizing some of its future annual and technical meetings outside the RECOFI region was reiterated as an excellent opportunity to visit commercial aquaculture operations, research facilities and to strengthen ties and collaboration with neighbouring countries.

### **ADOPTION OF THE REPORT**

65. The WGA Technical Secretary thanked all the participants for their contributions in the discussions particularly towards the finalization of the new WGA work programme proposal for the next biennium. The report of the meeting was subsequently adopted through email exchanges on Monday 22 November 2010.

66. The meeting participants thanked the Secretariat and the State of Qatar for the arrangement of the meeting and warm hospitality.

**APPENDIX A****Agenda and timetable****Wednesday, 27 October 2010****Morning: 08.30 hours**

1. Opening of the Session
2. Adoption of the Agenda and arrangements of the session: *for decision*
3. Status review of aquaculture development by country – Presentation of updated FAO National Aquaculture Sector Overviews (NASO): *for discussion*
4. Outcome of the Special Meeting on RECOFI Consolidation and Development (Rome, Italy, 11–12 May 2010) and considerations for the Working Group on Aquaculture: *for discussion*
5. Review and country follow-up of the outcomes of: *for discussion and recommendations*
  - Regional Technical Workshop on Aquatic Animal Health (Jeddah, Saudi Arabia, 6–10 April 2008)
  - Regional Workshop on Sustainable Marine Cage Aquaculture Development (Muscat, Oman, 25–27 January 2009)

**Afternoon: 14.00 hours**

6. Summary outcomes of the RECOFI Workshop on Spatial Planning for Marine Capture Fisheries and Aquaculture (Doha, Qatar, 24–28 October 2010): *for discussion and recommendations*
7. Follow-up on the Regional Aquaculture Information System (RAIS): *for discussion and recommendations*
  - Presentation of the RAIS Web analysis report (RAIS Regional Centre)
  - Implementation of the RAIS Communication Strategy at regional and national levels
  - RAIS National Coordinator's report on data collection and submission since the Fourth WGA Meeting
8. Update on the WGA programme of work and budget for the biennium 05/2011–05/2013 including a review of regional aquaculture development priorities: *for discussion and recommendations*
9. Election of the WGA Chairperson and Vice-Chairperson and Confirmation of WGA Focal Points and Alternate Focal Points: *for discussion*
10. Any other matter
11. Date and place of the Sixth Meeting of the Working Group on Aquaculture
12. Adoption of the Report

**APPENDIX B****List of participants****RECOFI MEMBERS****BAHRAIN**

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**APPENDIX C****List of documents**

RECOFI:WGA/V/2010/1	Provisional annotated agenda and timetable
RECOFI:WGA/V/2010/2	Outcome of the Special Meeting on RECOFI Consolidation and Development, Rome, Italy, 11–12 May 2010
RECOFI:WGA/V/2010/Inf.1	List of documents
RECOFI:WGA/V/2010/Inf.2	Report of the Fifth Session of the Regional Commission for Fisheries, Dubai, United Arab Emirates, 12–14 May 2009
RECOFI:WGA/V/2010/Inf.3	Report of the Fourth Meeting of the Working Group on Aquaculture, Muscat, Sultanate of Oman, 27–28 January 2009
RECOFI:WGA/V/2010/Inf.4	Report of the Regional Technical Workshop on Aquatic Animal Health, Jeddah, Kingdom of Saudi Arabia, 6–10 May 2008
RECOFI:WGA/V/2010/Inf.5	Report of the Regional Technical Workshop on Sustainable Marine Cage Aquaculture Development, Muscat, Sultanate of Oman, 25–26 January 2009
RECOFI:WGA/V/2010/Dma.1	A guide to recirculation aquaculture – an introduction to the new environmentally friendly and highly productive closed fish farming systems (Eurofish/FAO technical manual)

**Note:**

See Appendix O for the complete list of RECOFI publications from 2008 to present.

**APPENDIX D****The FAO “National Aquaculture Sector Overview” Programme**

The *National Aquaculture Sector Overview* (NASO) collection, consists of concise and comprehensive products, providing a general overview of the aquaculture and culture-based fisheries aspects at the national level. The preparation of NASO is part of the FAO Fisheries and Aquaculture Department regular programme and up to date 100 NASOs have been published in five FAO official languages in the FAO Web site ([www.fao.org/fishery/naso/search](http://www.fao.org/fishery/naso/search)).

The NASOs of the eight RECOFI Member countries are also available in the RECOFI RAIS Web site at the following [www.raisaquaculture.net/index.php?id=naso](http://www.raisaquaculture.net/index.php?id=naso).

All NASO follows the same basic and standard structure as indicated below:

- I. Characteristics, structure and resources of the sector
  - Summary
  - History and general overview
  - Human resources
  - Farming systems distribution and characteristics
  - Cultured species
  - Practices/systems of culture
- II. Sector performance
  - Production
  - Market and trade
  - Contribution to the economy
- III. Promotion and management of the sector
  - The institutional framework
  - The governing regulations
  - Applied research, education and training
- IV. Trends, issues and development
- V. References
  - Bibliography
  - Related links

**APPENDIX E****National Aquaculture Sector Overview (NASO) – BAHRAIN**

by

**Abdulredha J. Shams**Directorate of Marine Resources, Public Commission for the Protection of Marine Resources,  
Environment and Wildlife**CHARACTERISTICS, STRUCTURE AND RESOURCES OF THE SECTOR****Summary**

Commercial mariculture is not currently practiced in the Kingdom of Bahrain but there are very good opportunities for development in the near future. Recognizing the importance of aquaculture development, the Government's General Directorate for the Protection of the Marine Resources, has established the National Mariculture Centre to undertake applied research in this field. The National Mariculture Centre began as a pilot project in 1979 in cooperation with the Food and Agriculture Organization of the United Nations (FAO). The centre is located at Ras Hayan on the South-Eastern coast of Bahrain.

The National Mariculture Centre (NMC) has successfully achieved the mass propagation of seed from the following commercially important local species: rabbit fish (*Siganus canaliculatus*), Sobaity seabream (*Sparus hasta*), gilthead seabream (*Sparus aurata*), mangrove red snapper (*Lutjanus argentimaculatus*), brown-spotted grouper (*Epinephelus coioides*), streaked rabbit fish (*Siganus javus*) and green tiger shrimp (*Penaeus semisulcatus*). The success has been such that the NMC has begun to supply marine finfish seed to other member countries of the Regional Commission for Fisheries (RECOFI) of the Gulf Cooperation Council (GCC) region. The Kingdom of Bahrain is beginning to emerge as a potential leading marine finfish seed producer and exporter in the region.

Currently there are no commercial mariculture projects in operation in Bahrain, mariculture activities are limited to the applied research activities of NMC which includes studies in the areas of nutrition, reproduction, hatchery techniques, nursery and growout of the species indicated above, and the mass production of finfish juveniles. Major breakthroughs have been achieved in the growth trials on grouper, Sobaity bream and rabbit fish utilizing a variety of different production systems.

Due to scarcity of freshwater resources in Bahrain, all efforts have been diverted towards marine species. There are very limited land-based culture activities carried out in tanks.

A pilot-scale project using cage production systems was implemented with the aim of promoting this type of system. Bahrain is a small island nation with limited land resources. The expansion of extensive land-based developments would be at the expense of the marine environment, as a result, land-based shrimp culture, for example, is from a practical point of view not feasible. It is advantageous, however, for the country to promote private sector investments in intensive tank-based mariculture activities and open-water cage culture.

All research and production efforts are focused on the development and refinement of appropriate economically efficient technologies and the production of marine finfish juveniles both for sale and for release programmes as well as for the limited use in land based grow-out tanks.

## **History and general overview**

The Kingdom of Bahrain has good potential for fish farming considering the advantages offered by the climate, location, coastal area, and market. Many types of aquaculture activities are feasible and a wide range of aquatic species could be cultured. Bahrain, by virtue of its location, possesses rich finfish and shellfish resources, some of these have already been identified as potentially suitable for aquaculture development by the National Mariculture Centre, which forms part of the Directorate of Marine Resources, a member of the General Directorate for the Protection of Marine Resources within the Public Commission for the Protection of Marine Resources, Environment and Wildlife in the Kingdom of Bahrain.

Fish landing statistics in the country indicate a large and steady deficit in its supply of fish. Meanwhile, the demand and per capita consumption of fish products has continued to increase over the last two decades. This is due primarily to the increased public awareness about the health benefits of fish consumption. The fisheries resources in the waters surrounding the Kingdom cannot meet this increased demand. In the long-term, it is felt that investment in the development of an aquaculture sector will contribute to the food security and self-sufficiency of Bahrain and its ability to earn foreign exchange through the export of aquatic products.

## **Human resources**

Currently, the Directorate of Marine Resources consists of the Director, 21 professional and technical staff and 10 support staff who are involved in all mariculture activities undertaken by the National Mariculture Centre. The Director and the senior staff all have post graduate degrees. All technical staffs are well educated and trained in mariculture sciences with many years of experience in this field. The technicians are school graduates with extensive training and experience, working in different areas of mariculture research, such as brood stock management, hatchery techniques, live food production, juvenile and grow-out production, nutrition and fish pathology.

There are at present, proposals to increase the staff in order to meet the requirements for the proposed expansion of research activities and the promotion of commercial mariculture projects in the Kingdom.

## **Farming systems distribution and characteristics**

At present, there is no commercial aquaculture being carried out in the Kingdom, the only available culture facilities and equipments belong to NMC.

## **Cultured species**

The National Mariculture Centre has successfully achieved the mass propagation of seed of the following commercially important local species: rabbit fish (Safee) (*Siganus canaliculatus*), Sobaity bream (Sobaity) (*Sparidentex hasta*), brown-spotted grouper (Hamoor) (*Epinephelus coioides*), gilthead seabream (*Sparus aurata*), mangrove snapper (Sheggar) (*Lutjanus argentimaculatus*), streaked rabbit fish (*Siganus javus*) and green tiger shrimp (Rubian) (*Penaeus semisulcatus*).

Currently, production is taking place for the first four of the species listed above, gilthead seabream being the major contributor. Due to scarcity of freshwater resources in the country, all efforts are now being oriented towards marine species.

## **Practices/systems of culture**

Pilot-scale projects using cage production systems was carried out in an effort to promote this type of aquaculture. Bahrain is a small island country which possesses limited land resources for development. Expansion of extensive land-based developments is not feasible. It is advantageous,

however, for the country to promote private sector investment in intensive tank-based mariculture activities and open water cage culture.

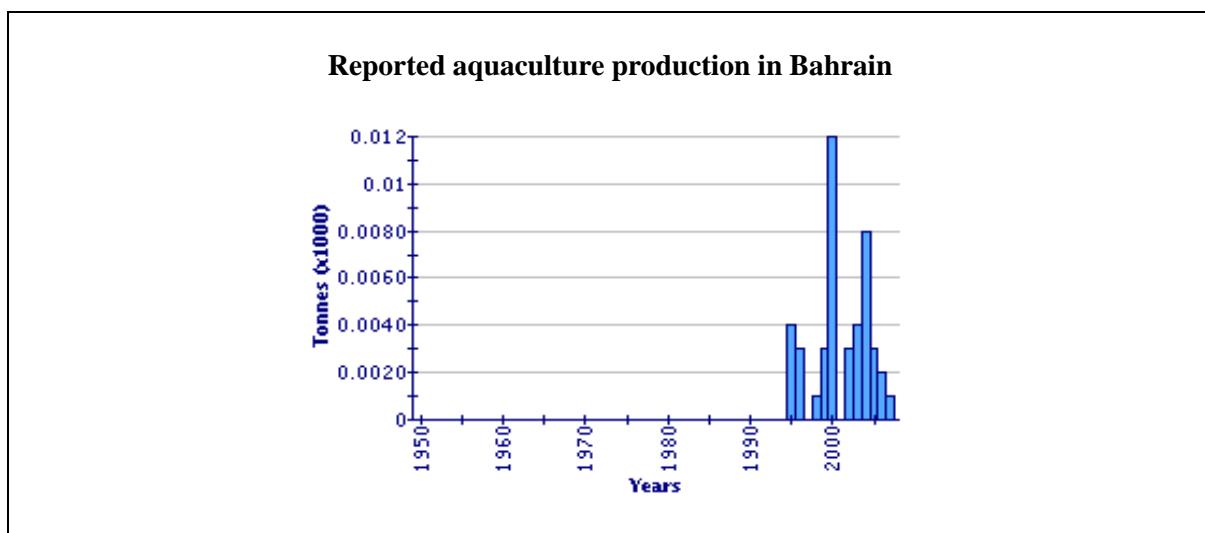
Research and production efforts are focused on the development and refinement of appropriate economically efficient technologies and the production of marine finfish juveniles both for sale and for restocking programmes as well as for limited use in land based grow-out tanks.

## **SECTOR PERFORMANCE**

### **Production**

The National Mariculture Centre is currently the leading producer of juveniles in the region for a wide range of marine finfish species. In 2008, juvenile production from three fish species nearly reached five million. The production of market size fish was about 2.0 tonnes. The Centre's production capacity could be significantly increased if problems related to seawater quality, shortage of facilities, improvement of the organizational structure and shortage in manpower and resources are resolved.

The graph below shows total aquaculture production in Bahrain according to FAO statistics:



(Source: FAO Fishery Statistics)

### **Market and trade**

Bahrain's aquaculture industry is still in its infancy; currently the production harvested from the NMC is marketed locally. Significant numbers of Sobaity bream, gilthead bream and grouper juveniles have been exported to all the countries in the region over the last few years.

The per capita fish consumption in Bahrain was 1 802 kg in 2000, this figure declined to 9.1 kg in 2007. The total fish landing showed an increase of 28 percent, while the population showed an estimated 60 percent increase over the same period (*Central Informatics Organization*. Kingdom of Bahrain).

### **Contribution to the economy**

Aquaculture has good prospects for boosting the national economy of the country in the near future.

## PROMOTION AND MANAGEMENT OF THE SECTOR

### The institutional framework

The Directorate of Marine Resources within the General Directorate for the Protection of Marine Resources which in turn forms part of the Public Commission for the Protection of Marine Resources, Environment and Wildlife is a leading government agency responsible for the management and development of the aquaculture sector. The Directorate also liaises with other government bodies on issues relating to aquaculture development.

Within this Directorate there are a number of different sections and units with various responsibilities for aquaculture development and sustainable management issues.

### The governing regulations

The government has recognized the importance of regulation to ensure the sustainable development of aquaculture, an unregulated and uncontrolled aquaculture sector will inevitably lead to many environmental, economical and social problems. All the rules and regulations relating to aquaculture are set within one framework that is transparent, enforceable and interlinked with other laws and regulations applicable within the Kingdom as well as relevant international law.

The Royal Decree on Exploitation and Utilization of the Marine Resources, issued in 2002, has provisions for controlling the culture of organisms using aquaculture such as licensing and quality issues. According to the law, a company may not undertake any aquaculture activities without permission from the authorized government body (Directorate of Marine Resources). It also controls the collection of seed from the wild. Aquaculture laws and regulations in Bahrain are constantly revised and up-dated in conformity with international standards and requirements.

The government's strategy is designed to guide the sustainable growth and management of Bahrain's aquatic resources for the production of high quality fish and seafood, also for the generation of wealth and employment for the local population. All strategy initiatives are being designed to promote sustainable development – "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Recognising the importance of environment, the Directorate of Marine Resources is committed to eco-friendly and environmentally sound aquaculture development.

### Applied research, education and training

The National Mariculture Centre under the jurisdiction of the Directorate of Marine resources is the government body that conducts applied and scientific research in the field of aquaculture. Its main objectives are:

- To create the scientific and technical base for the development of mariculture operations in Bahrain.
- To conduct appropriate scientific research projects and developmental programmes on the mariculture of living marine resources.
- To develop suitable culture systems for the environmental conditions found in Bahrain.
- To assist and encourage private sector investment in commercial fish farming and similar activities in the country.
- To mass produce seed of suitable and commercially important species for the fish farming sector.
- To produce market size fish in suitable culture systems for the local and international markets.
- To train national staff in aquaculture technology.

- To assist stock enhancement programmes through the mass production of seeds, fry and fingerlings to protect the local endangered marine resources from extinction.

The Biology Department of the University of Bahrain also conduct related academic oriented research in this field. Currently, only one private company has a technical cooperation agreement with the Directorate of Marine Resources aimed at developing mariculture activities.

The University of Bahrain offers a B.Sc. degree course in marine science within the Biological Sciences Department.

### **TRENDS, ISSUES AND DEVELOPMENT**

In the last two years, a number of private investors have shown serious interest in establishing fish farms. The Directorate of Marine Resources is conducting site surveys to determine and allocate suitable locations for these farms, on land and offshore. This will be an important step in formulating a master plan for the development of the aquaculture sector that will ensure controlled and sustainable development. The National Mariculture Centre has to be developed and equipped to give the necessary technical support for the upcoming industry.

This master plan will contain different sections relating to issues such as legislation and the integration of the approval process, environmental monitoring, fish disease control, sustainable management and development. This master plan will also include the nature of involvement of the different government authorities as well as the private sector in the management process of this sector.

More research in different fields of aquaculture is needed for improved future management of this growing sector. The main areas of research that could be focused on in future are:

- Identification of the most suitable local and exotic species for culture.
- Environment monitoring programmes.
- Fish health and disease control.
- Enhancement of the legal and administrative framework.

**APPENDIX F****National Aquaculture Sector Overview (NASO) – IRAN (ISLAMIC REPUBLIC OF)**

by  
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**CHARACTERISTICS, STRUCTURE AND RESOURCES OF THE SECTOR****Summary**

The Islamic Republic of Iran is located in the Middle East between latitudes of 25° 00' and 39° 47'N and longitude of 44° 02' and 63° 02' E. The total area of the country is 1 648 000 km<sup>2</sup> which includes 1 636 million km<sup>2</sup> land area and 12 000 km<sup>2</sup> of water surface. The coast line stretches for 2 700 km to the south in the Gulf and in the north along the Caspian Sea.

Weather conditions differ greatly across the country allowing a range of different types of aquaculture to be practiced. Fish farming in the Islamic Republic of Iran began with the enhancement of fish species selected from the Caspian Sea and then continued through the development of semi-intensive aquaculture utilizing various Chinese carp species as well as the rainbow trout (*Oncorhynchus mykiss*). In recent years, shrimp culture (Indian white prawn – *Penaeus indicus*) has become the main focus for Government investment in the Gulf region where it has been developed in earth ponds.

The total area of fish ponds in the Islamic Republic of Iran is estimated at approximately 26 250 ha. The major warm water species produced are the common carp (*Cyprinus carpio*) and the three main Chinese carps, namely, grass carp (*Ctenopharyngodon idellus*), silver carp (*Hypophthalmichthys molitrix*) and the bighead carp (*Hypophthalmichthys nobilis*). Of the total Iranian aquaculture production in 2004, Chinese carps represented 52 percent, rainbow trout 24 percent, Indian white prawn 8 percent and aquaculture-based fisheries production 16 percent. About 92 percent of the total aquaculture production is utilized mainly for domestic markets with the main export commodity being shrimp (42 percent of export value in 2003) and caviar.

Aquaculture production increased rapidly from 4 935 tonnes in 1978 to more than 124 000 tonnes in 2004, representing approximately 27 percent of the total fish production. This proportion is expected to increase during the fourth 5-Year plan which began in 2005.

The legal and institutional framework for aquaculture development in the Islamic Republic of Iran is relatively well established, and the law on conservation and harvesting of aquatic resources, approved by the Parliament in 1997, drives fisheries and aquaculture activities in the country.

As part of a stock enhancement programme along the southern Caspian coast, the Government has established eight hatcheries to produce bony fishes and sturgeon fingerlings. All aquaculture activities, including feed and larvae production, fish and shrimp culture, processing, marketing and trade are carried out exclusively by the private sector. The Government supports the private sector by providing low interest rate loans and suitable land at competitive prices.

**History and general overview**

Aquaculture activity records in Asia go back thousands of years. The Islamic Republic of Iran, however, has only given serious attention to this activity during the last three decades where investment in aquaculture development began in the early 1980s along the Caspian coast and in some of the south-western provinces. Initial attempts began with the culture of rainbow trout (*Oncorhynchus*

*mykiss*) near Tehran at Mahisara (Karaj) in 1959, the first warm water farm was established in Gilan Province by the Abzi Company in 1971.

Shrimp culture in the country has an even shorter history; it goes back only as far as 1991 when the Food and Agriculture Organization (FAO) assisted the Islamic Republic of Iran with the development of shrimp farming in the Gulf region. The industry has developed rapidly over the past seven years. Production reached approximately 9 000 tonnes in 2004.

Fish production from aquaculture and aquaculture-based fisheries increased from 4 935 tonnes in 1978 to more than 124 000 tonnes in 2004. The main types of aquaculture activities in the Islamic Republic of Iran are (i) warm water fish culture of Chinese carps; (ii) coldwater culture of rainbow trout; (iii) shrimp culture; and (iv) culture-based fisheries and juvenile production for stock enhancement.

### **Human resources**

The total number of people employed in fisheries has risen from 82 400 in 1992 to 156 470 by 2003 of which the number directly employed in aquaculture and aquaculture-based fisheries was 17 095.

Shrimp culture plays an important role in the alleviation of poverty and the creation of job opportunities along the southern coast of the country. It has created more than 3 000 direct, full-time jobs in farms and hatcheries and almost an equal number of indirect, full-time jobs in feed production, processing units, trade, distribution and support services. Moreover, the number of part-time jobs created in related sectors such as construction, transport, equipment services, etc. has also been significant.

### **Farming systems distribution and characteristics**

*Warm water fish culture* – There are almost 21 700 ha allocated for warm water fish farming around the country, producing some 65 000 tonnes of fish in 2004 or 56.5 percent of total aquaculture production. The provinces of Khuzestan, Gilan, Mazandaran and Golestan are the main geographical areas where warm water fish farms are located and account for 91 percent of the total warm water production (58 571 tonnes). Of the total warm water production in 2004, Mazandaran produced 42 percent; Gilan produced 28 percent, Khuzestan 19 percent and Golestan 11 percent.

*Coldwater fish culture (rainbow trout)* – Trout farms are distributed across the centre, the north-western and western parts of the country mostly in mountainous areas characterized by cool summers and cold winters. The farming system consists of simple raceway made of concrete through which water flows continuously. An increased number of farms along with improving farming techniques and facilities has boosted annual production of trout from 280 tonnes in 1978 to more than 30 000 tonnes by 2004.

The production of rainbow trout takes place in Charmahal va Bakhtiari (27 percent), Lorestan (21 percent), Fars (20 percent), Mazandaran (22 percent) and Kohkilouyeh (10 percent), respectively. In 2004, total coldwater production in these five provinces accounted for more than 15 percent of the total aquaculture production; rainbow trout alone accounted for more than 58 percent.

*Shrimp culture* – In 2004 shrimp production reached almost 9 000 tonnes produced from 4 253 hectares of coastal ponds, located mainly in four provinces in southern Iran (Islamic Republic of); compared to the previous year, production levels and land use increased by approximately 19 and 16 percent, respectively. The low price of shrimp on the world market and an outbreak of disease at one of the farm complexes (Choebdeh farm complex; Khuzestan province) were the major factors for not utilizing circa 8 000 available ponds for shrimp culture. The division between each of the four provinces in the southern part of the country which contain all the shrimp farming operations is as follows: Boushehr 63 percent, Hormozgan 22 percent and Sistan va Belochestan 15 percent. Due to the disease outbreak in Khozestan, there has been no production in this province since 2002.

**Culture-based fisheries** – Lakes and reservoirs with an area totalling 1.5 million hectares provide a huge capacity for freshwater aquaculture around the country. Amongst this total some 489 water bodies with an area of 0.5 million hectares are regarded as having good potential for aquaculture purposes and recreational fishing. At present some 514 000 hectares of natural and semi-artificial water bodies are under exploitation and in 2004 over 20 000 tonnes of fish were produced.

The potential to increase production from these water bodies is very promising, however, due to the lack of rain in dryer years some of these water bodies run the risk of drying out and, therefore, fisheries has become seasonal. The south-western region of the Islamic Republic of Iran (Khozestan Province) has good potential for receiving water from Iraq, however water-use policy in Iraq will affect fisheries in these vast areas. A similar situation exists in the eastern part of the country, where rivers from Afghanistan bring water to Hamon Lake in the Islamic Republic of Iran. These water bodies create job opportunities; income and food for the population living in these areas, however, the lack of proper policy or agreement with neighbouring states creates difficulties and an unstable income and lifestyle for people in the catchment areas of these water bodies.

### Cultured species

Warm water fish culture includes extensive rearing of three species of Chinese carp, namely grass carp (*Ctenopharyngodon idellus*), silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Aristichthys nobilis*) as well as common carp (*Cyprinus carpio*), introduced from China, Romania and Hungary. There has also been an attempt to introduce Indian carps to the existing warm water aquaculture operations with the aim of increasing income generation and diversifying fish products to meet the interest of the customer. Coldwater fish farming includes the rearing of rainbow trout (*Oncorhynchus mykiss*) in tanks and raceways. Rainbow trout has been introduced from several countries including the United Kingdom, Italy, Norway and France.

The shrimp farming system utilizes semi-intensive techniques aimed at the production of 3 tonnes/ha in rectangular earthen ponds. Indian white prawn (*Penaeus indicus*) is the main cultured species because of the availability of wild broodstock, easy maturation in captivity and its tolerance to variable environmental conditions (in particular temperature and salinity). Several experiments have demonstrated that the green tiger prawn (*Penaeus semisulcatus*) and the banana prawn (*Penaeus merguiensis*) are not suitable species for pond culture. The slow growth of *P. semisulcatus* and the high mortality of banana prawn are the main disadvantages to farming these species.

Farming of giant river prawn (*Macrobrachium rosenbergii*), beluga (*Huso huso*), freshwater bream (*Abramis brama*), milkfish (*Chanos chanos*), *Barbus sharpeyi* and pike-perch (*Stizostedion lucioperca*) is being promoted to farmers as a way of diversifying production, increasing income and providing increased marketing flexibility.

### Practices/systems of culture

**Extensive aquaculture** – Extensive aquaculture is practiced in inland lakes, dams and reservoirs across the Islamic Republic of Iran. The main reservoirs are located in the south-west and eastern regions close to the borders of Iraq and Afghanistan. There are many dams mainly in Khozestan province as well as the Aras dam on the Azerbaijan border, which provide excellent conditions for aquaculture based fisheries. Most of the reservoirs in Mazandaran along the Caspian coast are stocked mainly with Chinese and common carps. Aras dam in west Azerbaijan, Hamun Lake in Sistan and Baluchestan, Howr-al-Shadegan and Hawr-al-Hawizah in Khuzestan are the most important sites for the re-stocking of juveniles for subsequent harvest by inland fishermen once the fish have matured.

**Semi-intensive aquaculture** – Carp production in earthen ponds is the main form of semi-intensive production encountered, with 65 000 tonnes produced in 2004 from 21 700 ha of ponds. The usual pond depth varies between 1.8 to 2.5 m with a production time of approximately 5–8 months

depending on the temperature and type of feeding regime in place. Average production is 3.5 tonnes per ha, which is low compared to other states in Asia.

The combination of the four carp species varies depending on climatic conditions and the farm management system being implemented. The most common combination is as follows: common carp (*Cyprinus carpio*) 15–20 percent, grass carp (*Ctenopharyngodon idellus*) 5–10 percent, silver carp (*Hypophthalmichthys molitrix*) 60–80 percent and bighead carp (*Hypophthalmichthys nobilis*) 5–10 percent.

Production of rainbow trout takes place in raceways with the average production being approximately 20 kg/m<sup>2</sup>, this is low compared to production levels obtained in Europe. The total area utilized for rainbow trout farming is about 286.2 ha with the aim being to increase average production up to 30 kg/m<sup>2</sup> by the end of the fourth 5-Year plan. Shrimp farming in the Islamic Republic of Iran also falls within the semi-intensive category of production. In 2004 the average production per hectare was 2.17 tonnes, however, the Iranian Fisheries Organization intends to increase the average shrimp production by 3 tonnes/ha/yr by 2009.

**Intensive aquaculture** – Over the past few years, 108 licenses have been issued to the private sector for the development of recirculation production systems. Of this figure, thirty-two farms with a capacity of 2 400 tonnes are operational and a further 22 farms are under construction. Total production of rainbow trout using this method was 430 tonnes in 2002 or 3 percent of the total production of rainbow trout. Farms equipped with aerators (paddle wheels and air jets) aim for higher production levels of between 8–13 tonnes/ha, however, the lack of adequate equipment and design has led to lower productivity levels than predicted using this system while still incurring higher production costs compared to raceway systems.

**Integrated farming systems** – Integrated farming systems (utilizing waterfowl, rice and fish culture) are not common. Over recent years, however, the Iranian Fisheries Organization (Shilat) has received funding to introduce new techniques to increase the productivity of both water and soil resources in the agriculture sector. Fish culture in paddies (following the harvesting of rice) and irrigation reservoirs have brought about considerable benefits to rural families including food security. Around 13 percent or 2 100 tonnes of the total rainbow trout production is produced using integrated systems as are 740 tonnes of Chinese carp (1.3 percent of total production). With regard to the extensive rice paddies found on the Caspian coast, it seems that further development and expansion of this system is feasible.

**Fish cage culture** – Most fish cages are located in lakes and dams with rainbow trout production from cages being 350 tonnes in 2004. A development plan is underway in the Caspian Sea, Persian Gulf and the Gulf of Oman for the development of marine cage culture and a pilot project with 6 cages has been established at Qeshm Island in the Hormozgan province for experimental research into mariculture. The candidate species for mariculture development include groupers (Serranidae), cobia (*Rachycentron canadum*), silver pomferet (*Pampus argenteus*) and fourfinger threadfin (*Eleutheronema tetradactylum*).

**Fish hatcheries** – In order to support the requirements of the growing fish farming industry several government run fish hatcheries were established for rainbow trout production in 1988 in Yasuj (Kohgiloooyeh Province) and Kelardasht (Mazandaran Province). In 2004, more than 95 percent of the juveniles were produced by the private sector. The Iranian Fisheries Organization allocated the state owned hatcheries for the production of juvenile sturgeon and other bony fishes for use in the re-stocking of the Caspian Sea under its stock enhancement program.

## SECTOR PERFORMANCE

### Production

According to the Iranian Fisheries Organization's statistical year books, the total production from aquaculture and aquaculture-based fisheries was 45 300 tonnes in 1994, approximately 13 percent of the total fisheries production (350 000 tonnes). However, by 2004 this figure increased to more than 124 000 tonnes or 28 percent of total fish production.

**Table 1. Aquaculture and aquaculture based fisheries production in Islamic Republic of Iran 1997–2004**

	1997	1998	1999	2000	2001	2002	2003	2004
Warm water	27 183	27 374	23 000	27 500	28 060	54 801	61 084	65 000
Coldwater	2 514	4 994	7 000	9 000	12 170	16 026	23 138	30 000
Shrimp	523	869	1 800	4 010	7 630	5 990	7 492	9 000
Aquaculture-based fisheries	34 780	38 763	36 000	25 490	25 785	13 010	18 461	20 000
Total	65 000	72 000	67 800	66 000	73 645	89 827	110 175	124 000

(Source: Iranian Fisheries Organization Statistical Year Book, 2005).

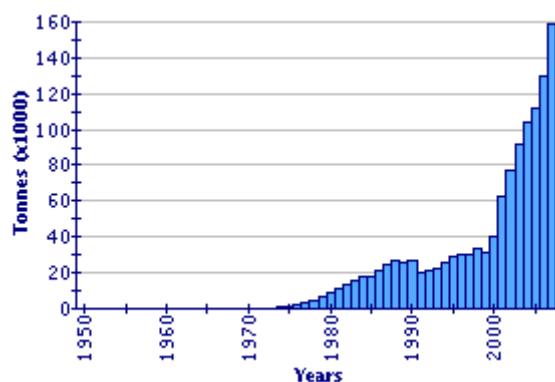
**Table 2. Aquaculture in the Islamic Republic of Iran in 2003**

Aquaculture Sources	Surface area (ha)	Employment	Number of farms
Aquaculture based fisheries	450 000	3 500	220
Coldwater	286.2	6 000	2 610
Warm water	21 700	5 900	4 500
Shrimp	4 085	3 349	310
Total	76 071	18 749	7 640

(Source: Iranian Fisheries Organization Statistical Year Book, 2005).

For comparison with the nationally produced statistics outlined in table 1, the following graph showing total aquaculture production reported to FAO, does not include capture-based aquaculture.

**Reported aquaculture production in the Islamic Republic of Iran**



(Source: FAO Fishery Statistics)

## **Market and trade**

Fish is not a popular part of the Iranian diet, especially in its central cities, which possess the main proportion of the population. Per capita consumption was 1 kg/year in 1980 and reached 6.13 kg by 2003. Expansion of aquaculture throughout the country, together with an increase in people's knowledge of fish as a healthy food, is helping to change people's attitude to fish and marketing campaigns by the Iranian Fisheries Organization and Ministry for Health has also helped to enhance fish consumption in the Islamic Republic of Iran. One of the main objectives of the Iranian Fisheries Organization is to increase consumption by 2009 to as much as 10 kg/person.

Aquaculture and fisheries production takes place mainly in the remote southern areas of the country, where food security due to lack of infrastructure is very important to the government. From a food security and job opportunity aspect the fisheries industry is in a favourable position and government investment in this sector is substantial. A fish consumption campaign, initiated by the Iranian Fisheries Organization, has been in place since 1998 particularly in inland cities and it seems to have had a positive effect on the people's diet.

The value of agricultural commodities exported in 2003 was USD 998 million of which approximately 6 percent were fish and 12 percent animal products, respectively.

## **Aquaculture contribution to the economy**

The contribution of aquaculture to fishery production has progressively increased, a production of 4 900 tonnes in 1978 (less than 1 percent of total fishery production) increased to 124 000 tonnes in 2004 (more than 27 percent of total fishery production). The role of fisheries as a contributor to the Iranian economy is very small, in fact only 0.23 percent in 2002, its share of the agricultural sector is also very low (2.2 percent), but with good potential for increases in production, it seems likely that its contribution to the country's economy will also increase in the future.

## **PROMOTION AND MANAGEMENT OF THE SECTOR**

### **The institutional framework**

The Iranian Fisheries Organization (Shilat), which governs all fisheries activities in the country, is responsible for fisheries development including both the aquaculture and fisheries industries. It is affiliated to the Ministry of Jihad-e Agriculture and the head of the Iranian Fisheries Organization has the rank of Vice Minister.

The main responsibilities of the Iranian Fisheries Organization within the aquaculture sub-sector are as follow:

- Aquaculture development research and implementation.
- Planning and preparation of the national development plans.
- Identification and training in the aquaculture sector.
- Improvement of existing farmers' knowledge.
- Promotion of new culture systems.
- Fish stock enhancement programmes.
- Investment in aquaculture infrastructure.

The construction and operation of any fish farms require licenses and consists of three steps, i.e. (1) acceptance of the plan (primarily agreement); (2) Permission for construction of the farm; and (3) farm operation and production licenses.

It should be noted that some traditional and small scale aquaculture does not need to follow this procedure. All fisheries offices in the local area can issue permission for integrated or small-scale fish farming to be carried out.

### **The governing regulations**

The legal framework of the Iranian Fisheries Organization is based on the "Protection and Exploitation of Natural Aquatic Resources Law" approved in 1997 by the Parliament. The Iranian Fisheries Organization is also responsible for the provision of related regulations and codes of practice for aquaculture management and development.

The General Guidelines for Aquaculture and Fisheries, adopted in 1999, provides the legal framework for aquaculture activities. The guidelines indicate the authority and clarify the responsibilities of four major related organizations, including the Iranian Environmental Organization, the Iranian Veterinary Organization, Iranian Natural Resources Organization and finally, the Ministry of Energy (Water Resource Organization).

According to guidelines, a formal license is required for activities such as fish farming in water bodies where aquaculture is not the major activity, for example irrigation canals and reservoirs, but they do not need to follow all the formal procedures, farmers usually obtain a letter of approval from the nearest Fisheries Department. The duties of each agency in the licensing procedure are clearly defined by the parliament and Council of Ministers.

### **Applied research, education and training**

The Iranian Fisheries Research Organization (IFRO), established in 1990, covers all fisheries research activities. It has six affiliated centres situated on the Caspian Sea (Gilan and Mazandaran), the Persian Gulf and the Oman Sea (Khozestan for freshwater; Boushehr for Persian Gulf Area; Hormozgan for Sea of Oman; and Chabahar for high seas fisheries).

The objectives of IFRO are to perform applied research in subjects related to aquatic organisms and their environment, for example, on stock recovery, sustainable exploitation of fish resources and environmental protection in Iranian waters. These objectives are referred to in the third Iranian fisheries company constitution article that was approved on 5 February 1985 by the Ministry Council and is the subject of the second protection and exploitation law for aquatic resources of the Islamic Republic of Iran approved on 5 September 1995 by the Iranian Islamic Parliament.

There is also an additional research institute that deals exclusively with the sturgeon resources of the Caspian Sea. The International Institute for Sturgeon Research aims to concentrate on encouraging scientists from around the world to conduct research on the Caspian Sea in Iran.

The Supreme Committee of Research is responsible for approving fisheries research projects in the country, university professors, representatives of executive departments of the Iranian Fisheries Organization and some experienced researchers and experts constitute the members of the committee.

The outcome of research projects are submitted to the Fisheries Organization who in turn apply the results, where appropriate, to fisheries development and improvement; subsequently pilot projects are run and modified accordingly. The results are then transmitted to the farmers, fishermen and related industries through services such as short training courses, workshops and manual guidelines. To assist with this process, training centres are found in various locations, including coastal areas, which play a vital role in conveying the results of research to the fisheries related industries. Since 2000, all research departments affiliated with the Ministry of Agriculture have been gathered into one single scheme under the Vice Minister of Agriculture for Research and Training.

Universities have an extensive capacity for research activities; however, as yet there is no proper systematic link between the universities and industry. According to Iran's third five-year plan, if 40 percent of funding is allocated to research directly from the industry, the Minister for Science, Research and Technology will grant the remaining 60 percent of the funding required for these research projects. Since 1970 the Ministry of Science, Research and Technology has organized a fisheries science course within Iran's university programmes. At present, eight state and twelve open universities offer bachelor courses, and four state and two open universities offer master and post-graduate courses in various fields related to fisheries and aquaculture. The universities of Tehran, Chamran (Khuzestan Province), Tarbiat Modarres (Mazandaran Province) and Gorgan (Golestan Province) are the oldest universities in the field of fisheries science. In addition, the University of Applied Sciences offers fisheries training courses in two faculties located on the Caspian Coast (Rasht) and Boushehr (Gulf region). The University gives priority to applied topics aimed at meeting the needs of the fisheries industries.

Training and extension centres affiliated with the Iranian Fisheries Organization are alternative sources for courses in order to improve skilled manpower; these centres implement several short training courses in various fields for both illiterate and literate farmers, fishermen and related industries as well as people with higher levels of education.

### **TRENDS, ISSUES AND DEVELOPMENT**

Iran's future fisheries and aquaculture development plans are aimed at increasing fish production, improving the welfare of fishermen and fish farmers, promoting exports, increasing fish consumption and providing food security. The per capita availability and consumption of fish is to be increased to a level of 10 kg per annum and production must therefore be increased proportionately.

In order to meet the future demand for fish, aquaculture has been recognized as an important source of production. A number of schemes have been instituted by both regional and central government sectors to increase both brackish and marine aquaculture and fish production from cages as well as in ponds, lakes, reservoirs and rivers. The private sector has emerged as the major player in aquaculture investment, particularly in shrimp and warm water farming. Seafood exports are now recognised as a major source of export earnings.

In order to meet European Union (EU) regulations, massive centrally sponsored schemes have been initiated to provide infrastructure at fishing harbours and fish landing centres to improve fresh fish handling and provide sanitation and other assistance for the development of quality processing of fisheries products. Shilat, the Iranian Fisheries Organisation, in line with the government has already developed its fourth 5-year plan for fisheries which began in 2005 and will continue until 2010. In this plan, it is intended to follow-up on the following goals:

- Food security through increased domestic fish production.
- Quality improvement and waste reduction in fisheries.
- Fish export promotion.
- Market improvement.
- Fish conservation and enhancement.
- Deep sea fisheries development.
- Improvement of aquaculture productivity.
- Expansion of applied research.
- Increase of fish consumption.

**Table 3. Planned aquaculture production trends (tonnes) in the fourth 5-Year plan 2005–2009**

	2004	2005	2006	2007	2008	2009
Aquaculture-based fisheries	20 000	22 730	24 506	26 345	27 760	29 881
Shrimp	9 000	14 110	23 800	32 300	40 500	47 200
Coldwater fish	30 000	32 312	38 617	46 436	53 536	60 361
Warmwater fish	65 397	72 231	80 803	95 158	110 251	133 277
Mariculture	0	600	1 000	2 000	2 900	4 500
Total	124 397	141 983	168 726	202 239	234 947	275 219

(Source: Iranian Fisheries Organisation Statistical Year Book, 2005)

It is expected that the total annual fish production from aquaculture sources will be increased from 124 000 tonnes in 2004 to 275 219 tonnes by the end of 2009. The main sources of fish production will be shrimp culture (approx. 47 000 tonnes), warm water fish culture (133 227 tonnes) and coldwater fish culture (approx. 60 361 tonnes). Warm water fish production forms the major portion of aquaculture output in the fourth 5-Year plan and the trend in this field will be towards better utilisation of the indigenous fish species reaching 20 percent of the total production at the end of the plan.

Shrimp culture is a very promising area for production increases and the entire coastline of the southern (the Persian Gulf and Gulf of Oman) and some parts of the northern coast (Caspian Sea) of the country are suitable for this industry.

**Marine fish farming** – With the assistance of a Norwegian company, the Iranian Fisheries Organization has studied the potential for marine fish farming on the northern coast of the Persian Gulf and the Gulf of Oman, the results of which indicate good potential for cage culture in various areas. The study reveals that for an initial phase approximately 100 000 tonnes of fish could be produced in cages.

The candidate species for mariculture development include Groupers (Family: Serranidae), cobia (*Rachycentron canadum*), silver pomferet (*Pampus argenteus*) and fourfinger threadfin (*Eleutheronema tetradactylum*).

**Artemia culture** – *Artemia* production in the marine water reservoirs of petrochemical plants is a profitable industry in the Khuzestan Province. There are also good examples of *Artemia* culture in shrimp farms as a second additional crop. The unstable market price for the cyst and low demand for biomass are the major constraints against the expansion of this activity. The Uremia Lake holds significant potential for *Artemia* and cyst production as shown by a study conducted by the University of Ghent in Belgium.

**Oyster and pearl farming** – Gulf pearls are well-known on the international market, however, due to over fishing, oyster stocks have been reduced dramatically. With the aim of stock enhancement, the Iranian Fisheries Research Organization has conducted various research projects for seed production and in 2004 successfully produced seed. Access to seed production technology could lead, in the future, to pearl culture activity.

**Seaweed culture** – There are more than 130 species of seaweed found in the Iranian marine waters. *Gracilaria* spp., *Sargassum* spp. and *Eucheuma* spp. are some of the commercial seaweed species. Over the past four years several trials have been carried out on the farming of *Gracilaria* in ponds and the open sea and a pilot project has been initiated to develop commercial seaweed farming.

**APPENDIX G****National Aquaculture Sector Overview (NASO) – IRAQ**

by

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General Board of Fish Development, Ministry of Agriculture

**CHARACTERISTICS, STRUCTURE AND RESOURCES OF THE SECTOR****Summary**

In Iraq, fish production relies on inland and marine fisheries because no particular attention was given to aquaculture in the past. In developing this sector, the aquaculture in Iraq depends on the availability of water, as well as, good soil and adequate sites.

The rivers Tigris and Euphrates, including also the country's tributaries, marshes, dams and reservoirs comprise Iraq's main water source. Iraq has a limited coastline of approximately 59 km bordering the Gulf with a water surface area of approximately 700 km<sup>2</sup>.

Despite the availability of water resources, freshwater aquaculture production is limited to pond culture of common carp (*Cyprinus carpio carpio*). There is also a limited culture of grass carp (*Ctenopharyngodon idellus*) and silver carp (*Hypophthalmichthys molitrix*). In 2007, the total production deriving from freshwater and marine aquaculture was estimated to be approximately 16 000 tonnes.

The aquaculture sector is owned at the public and private level. These two sectors are widely distributed in the middle and southern parts of Iraq.

Freshwater aquaculture and inland fishery have experienced a negative development due to the innovative approaches to inland fisheries production that have not evolved as capacity building initiatives among Iraqi fisheries. Furthermore, aquaculture scientists, extension officers and farmers were hindered, as a result of being isolated from the international scientific community, due to the security situation in Iraq. As a consequence, this led to a lack of diversification of the inland fishery industry during the post international economic embargo period. In addition, progress in freshwater aquaculture development is mainly also hindered by a limited supply of good quality fish seed and feed and a lack of diversity in terms of cultured species and practices. However, there is potential to optimize freshwater aquaculture production through better management and enhancement of the diversity of species through an effective regulatory framework. The sector is managed by the General Board for Fish Resource Development, comprising of technical and administrative divisions, which plans and manages new projects, and the establishment of hatcheries to reproduce local fish within various governorates. with a scientific collaboration between the General Board and the scientific institutions and universities in the country. The aim is to carry out training and build up capacity with a view to developing the aquaculture sector.

**History and general overview**

In the 1950s, carp species were introduced for the first time in Iraq, but only for scientific research purposes. The main aim was to acclimatize these species in the Iraqi inland waters and to establish whether they would be suitable for rearing in the Iraqi environment without interference and without a negative impact on endemic species. However, at that time, this experience was not channelled into commercial activities.

Later, significant attention was given to the aquaculture sector, initially with the establishment of hatcheries and the construction of fish farms.

The first artificial reproduction was started recently in Iraq, by following up on the experimental phase. However, the reproduction and rearing of local fish species was not carried out sufficiently, due to a lack of knowledge of the biology of the species.

The aquaculture sector developed after 1954, but was not given any importance or particular attention. It was limited by laws, codes and regulations which protected, organized and utilized the existing fishing techniques in inland waters. In 1985, hatcheries, as well as, farms for fish reproduction and rearing were built, but these farms were too small, and not suitable for commercial purposes.

In 1989, the General Board for Fish Resource Development was disbanded and became a branch under the Animal Resource Services Company. In 2004, the General Board for Fish Resource Development restarted as an independent state institute to assume responsibility as a scientific authority to improve fish production in Iraq, by applying fisheries and aquaculture science methodologies.

A number of developmental projects, assisting directly and indirectly the development of aquaculture and the inland fishery industry in Iraq have been carried out, for example, upgrading the central fish hatchery and laboratory at Wasit, rehabilitating fish farming sites in several areas in the country, building a functional hatchery for local fish species production and the building of operational closed recirculating systems and pilot cages.

There have also been several initiatives to restore the Mesopotamian marshes, which have offered opportunities for intervention to increase fish production by releasing fingerlings of local species, as well as, carp species. Farmers and fishermen have also been supported by means of easy loans or through the establishment of natural protectorates in the Mesopotamian marshes.

Marine aquaculture has not been developed at all due to a lack of competencies in this sub-sector as there is no know-how on reproducing or culturing fish in marine waters. Marine fish have only been caught by private fishing boats located in Basrah.

### **Human resources**

Manpower employed in the fishery and aquaculture pertain to public and private sectors. Those employed in the private sector are mostly fishing in inland water bodies rather than working in aquaculture, but a few are involved in the basic work on the fish farms. The better educated and more skilled in this field, work with various public organizations. There are about 300 highly educated experts, such as diploma holders or with bachelor degrees and only 15 percent have a master's degree or Ph.D. which currently work in research centres and universities.

- Loading & unloading workers 2 200
- Support workers 1 100
- Fishing sector/fishermen 6 023
- Aquaculture sector 2 690

### **Farming systems distribution and characteristics**

Iraq has diverse water resources which are thought to be suitable for enhancing its fishery resources, especially in inland water bodies which cover around 600 000 to 700 000 hectares, comprising natural lakes (39 percent) dams and reservoirs (13.3 percent) rivers and their branches (3.7 percent) and marshes (44 percent).

The farming system rely mainly on fish farms which are widespread within the middle and southern part of Iraq and are mainly based on extensive and semi-intensive fish ponds culture.

## Cultured species

Freshwater fish production consists of pond culture of the common carp (*Cyprinus carpio carpio*), as well as the grass carp (*Ctenopharyngodon idellus*) and the silver carp (*Hypophthalmichthys molitrix*). There have been no initiatives to provide opportunities for the development of native fish production due to a limited supply of good quality fish seed, a lack of scientific knowledge and because native species are economically worthless to be produced or cultured in ponds. Such species require 4–5 years to reach marketable size.

## Practices/systems of culture

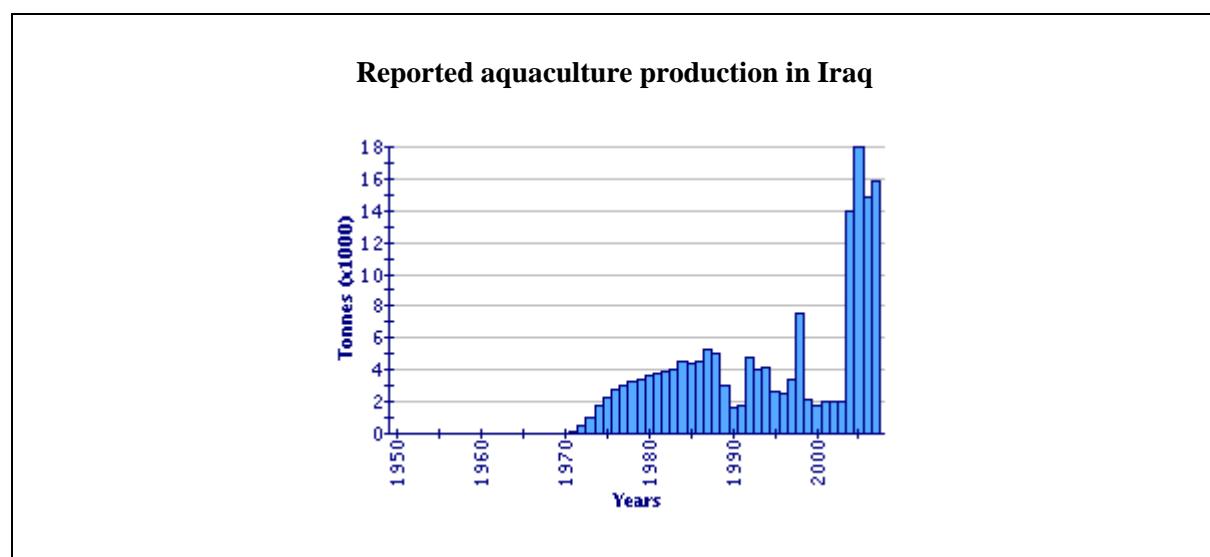
Pond culture is the practice currently applied. Due to the international economic and scientific embargo during 1990–2004, Iraqi scientists and experts experienced great difficulties in communicating with scientists outside the country. As a consequence, this isolation contributed to creating a gap and decline in all aspects, especially in the field of scientific research. As a result of this, fishery and aquaculture studies and research went through a negative development.

Research and studies are currently being carried out in the area of acclimation and artificial reproduction, of the native *Barbus* sp., exclusively at the Sewera central hatchery. Successful results have previously been achieved from the acclimation of *Acanthus purges* lotus at Al-Razaza Lake, which is an enclosed salty lake. With the collaboration of various scientific authorities, the General Board for Fish Resource Development is carrying out research and studies on these desirable species in order to reproduce this build up hatchery, especially near Al-Razaza Lake.

## SECTOR PERFORMANCE

### Production

The graph below illustrates total aquaculture production in Iraq according to FAO reported statistics:



(Source: FAO Fishery Statistics)

### Market and trade

No fish is exported as a result of limited production of seafood from the aquaculture and fishery sector and the increasing demand for fish, however, imports of frozen, live and canned fish are widely in progress.

Seafood is mainly imported from the Islamic Republic of Iran, the United Arab Emirates, Oman, Egypt, Morocco, China, Thailand, Myanmar, Pakistan, India and South America.

### **Contribution to the economy**

The aquaculture and fishery sectors only provide a slight contribution to the national economy by providing a limited production, as well as, providing jobs with limited income, resulting from low-scale production both from fish ponds and capture fisheries. Most fish farmers have additional employment other than rearing fish.

The state sector does not currently have a fishing fleet. All the fishing activities are carried out in the Gulf by the private sector, which owns primitive fishing boats and equipment.

## **PROMOTION AND MANAGEMENT OF THE SECTOR**

### **The institutional framework**

The General Board for Fish Resource Development is the main authority responsible for developing and upgrading the fishery and aquaculture sectors, encouraging investment, developing procedures through better management, stocking and enhancement of species diversification through an effective regulatory framework for both the inland and marine fisheries, as well as, aquaculture. At present, there is a potential to optimize research and studies into different local species which are currently under the acclimation process. The General Board comprises many technical or administrative departments and divisions. The technical departments are responsible for fish reproduction and rearing, providing fingerlings and good quality fish seed for the farmers. The internal Fishery Department is responsible for supervising fishermen, fishing licenses, fishing boats and the fish trade (wholesale). The studies and investment department deals with new project proposals to be implemented. The General Board, together with other scientific institutions, is responsible for research and studies of the different technical aspects to serve the development of the fishery and aquaculture sectors in order to increase production.

The General Board is the main executive power with authority to apply the rules and regulations issued by the government in collaboration with the Ministry of the Interior to apply the relevant Law No 48, issued in 1976, and its codes which regulate fisheries and aquaculture to better manage aquatic living resources. This institution does not have enough staff to monitor adequately law application due to the extent of the water bodies.

The fishery associations cooperates with the General Board to support and facilitate fishermen communities through the releasing of legal licenses to the fishermen and boats, as well as, encouraging the members by providing easy loans and the requirements to improve their work.

The following communities are related to fisheries:

- Two non-governmental organization (NGOs) in Basrah for marine fishes.
- The fisheries cooperative at Al-Kut for fishing in the Al-damlag marshes (NGO) total members 80.
- The fisheries cooperative at Al-Najaf for fishing in the Eben-najem marshes.
- The fisheries cooperative at Karbala for fishing in lake Al-Razaza.

### **The governing regulations**

A legal license is required to practice fish rearing, developing trading or any work related with fish. In order to start any fishery or aquaculture activity, a letter of agreement must be obtained from the authorities.

### **Applied research, education and training**

In collaboration with FAO, the General Board has designed a scientific training programme to rehabilitate and restore fish resources in Iraq, in order to develop and build up the capacity of the staff. At the same time, there is scientific research collaboration between the General Board and the universities, as well as, all institutional research centres to assess the status of the fisheries resources in Iraq.

The following scientific institutes are involved in this research:

- Marine science centre (Basrah)
- College of education/Iben-Al-Hytham/Biology Department
- Ministry of science and Technology/Fisheries department
- College of sciences/Basrah university/Biology Department
- Technical college technique/Babil
- Technical Institute/Babil
- Veterinary college

### **TRENDS, ISSUES AND DEVELOPMENT**

The past policy, caused the aquaculture sector to collapse. In addition, the international embargo, which interrupted all means of communication with the rest of the world, coincided with the dissolution of the General Board (1989). In 2004, the expert staff returned to work, to reorganize this sector by reinforcing their scientific skills to restore the facilities and infrastructure for this vital food resource. A lot of work has been followed up by studies, research, training programmes and continued effort together with international institutes, universities and organizations.

The General Board plans to carry out new aquaculture projects, mainly for establishing hatcheries to reproduce local fish in different governorates.

Several pilot projects were recently funded to test cage culture in inland waters bodies as well as a closed recirculating system and modern hatcheries to improve fish stocks enhancements.

**APPENDIX H****National Aquaculture Sector Overview (NASO) – KUWAIT**

by  
**Haider A. Murad**  
 Public Authority for Agriculture and Fish Resources

**CHARACTERISTICS, STRUCTURE AND RESOURCES OF THE SECTOR****Summary**

Aquaculture is a relatively new and potential source of fish production in the State of Kuwait. It is currently being expanded in order to supplement local landings from capture fisheries. Two types of aquaculture systems are practised in Kuwait: Nile tilapia (*Oreochromis niloticus*) culture in concrete tanks using brackish water on agricultural farms and, culture of gilthead seabream (*Sparus aurata*), European seabass (*Dicentrarchus labrax*) and Sobaity seabream (*Sparidentex hasta*) in cages located in Kuwait Bay.

Tilapia culture is carried out in 56 farms in three areas throughout the country, namely Al-Abdaly, Al-Wafra and Al-Sulybia. Annual average production of tilapia has been recorded as 327 tonnes from the year 2005 to 2008.

Fish culture using marine cages has been carried out in the State of Kuwait since 1992. Marine finfish cage culture is presently being carried out by a Kuwaiti-based shareholding company registered as “Bubiyan Fisheries Company” which was established in 1986.

The actual number of cages currently being used is only a small fraction. The reason for this may be attributed to the unavailability of fish fingerlings, unfavourable market trends and unsuitable environmental conditions. As no hatchery or fish feed production facilities are available within the company, fingerlings of gilthead seabream are mainly imported from Greece, France and other Mediterranean countries. Fingerlings are now also being produced in Kuwait by a newly established company called “Gulf International Aquaculture Company” (GIAC) which uses part of the hatchery unit belonging to the Kuwait Institute for Scientific Research (KISR) on a rental basis. The Government encourages the establishment of aquaculture activities providing a feed subsidy. The subsidies are provided to the sector, as it has been identified as a potential source of seafood to supply the future demand for fish in the State of Kuwait.

**History and general overview**

Although options for aquaculture development through research have been explored since 1983 by the KISR, aquaculture activities gained momentum in 1990 through the concerted efforts of the Public Authority for Agriculture Affairs and Fish Resources (PAAFR). In 1992, the Bubiyan Fisheries Company began commercial production of gilthead seabream and sobaity in floating cages in Kuwait Bay. Aquaculture of Nile tilapia (*Oreochromis niloticus*) began in 1997 as an integral part of agriculture using brackish water. The establishment of a commercial private hatchery by the GIAC and the tilapia hatchery at Al-Wafra by the PAAFR are an indication of the growing potential for aquaculture production in Kuwait.

**Human resources**

In 2008, approximately 170 professional and technical workers were engaged to look after the cage culture activities in Kuwait. The technical staff of the aquaculture division in the Fisheries Department

of PAAFR administers aquaculture activities and researchers at the Fisheries and Mariculture Department of KISR are engaged in aquaculture research and development.

### **Farming systems distribution and characteristics**

**Integrated Tilapia culture in agriculture farms** – Nile tilapia (*Oreochromis niloticus*) culture is carried out in agriculture farms where crops such as alfa-alfa (*Medicago sativa*), tomatoes, potatoes, onions, etc., are cultivated. The farms are located in the Al-Wafra, Al-Abdaly and Al-Sulybia areas. Concrete tanks are used for tilapia culture. The size of the tanks ranges from few m<sup>2</sup> to hundreds of m<sup>2</sup> with depths of 1 to 2 m. Most of the tanks are built above ground level to facilitate bottom drainage. Culture is carried out using brackish water with a salinity of 5–8 ppt pumped from underground wells. Each farm has a water reservoir tank. The drained water is used for the irrigation of alfa-alfa and other crops. In some farms greenhouse shelters are used to cover the tanks.

The stocking rates vary between ten and 50 fingerlings/m<sup>3</sup>. Fish attain a marketable size of 350–400 g within six to eight months. Pelleted fish feed is partially supplied by the PAAFR on a subsidy basis. Tilapia culture is carried out on 56 farms and the total volume of the concrete tanks is approximately 39 300 m<sup>3</sup>. Of the 56 farms, 37 are located in Al-Wafra, 17 in Al-Abdali and two in Al-Sulybia. Annual average production of tilapia from these farms is recorded as 327 tonnes from the year 2005 to 2008. Tilapia species were initially imported from Kenya for aquaculture experimental trials. Tilapia is currently cultured on a commercial-scale. The PAAFR has established a new hatchery at Al-Wafra which supplies tilapia fingerlings to the farmers.

**Fish culture in cages** – Fish culture in floating cages began in 1992. Although various species have been used, gilthead seabream (*S. aurata*) and Sobaity seabream (*S. hasta*) are the most suitable species. The cages operated by the Bubiyan Fisheries Company are located in the Ras Kathmoh Marine Area near Doha Port in Kuwait Bay, where the water depth is approximately 11 m. The company owns 73 floating cages in the Doha area and produces an annual average of approximately 250 tonnes of fish.

Aquaculture production in cages consists mainly of gilthead seabream. The Kuwait Institute for Scientific Research has developed a hatchery unit with the latest infrastructure facilities. Part of the hatchery is used on a rental basis by the private company GIAC. The company produces annually in the region 800 000 fry and exports fingerlings of Sobaity, yellowfin seabream (*Acanthopagrus latus*) and orange-spotted grouper (*Epinephelus coioides*) for fish culture in cages.

### **Cultured species**

Aquaculture production in the State of Kuwait consists mainly of two species: Nile tilapia (*Oreochromis niloticus*) and gilthead seabream (*S. aurata*). Tilapia was originally introduced for research purposes. The Kuwait Institute for Scientific Research commenced tilapia culture in 1983 on an experimental basis, after the Public Authority for Agriculture Affairs and Fish Resources began integrating tilapia culture with alfa-alfa. Commercial production of tilapia began in 1997. Gilthead seabream (*S. aurata*) was introduced from Greece. The commercial production of this Mediterranean species began in 1992 by the Bubiyan Fisheries Company. Fingerlings are now imported primarily from France.

Other cultured species are Sobaity seabream (*Sparidentex hasta*) and European seabass (*Dicentrarchus labrax*).

### **Practices/systems of culture**

**Intensive tilapia culture system** – Tilapia culture is carried out integrated with agriculture farms using concrete tanks. Brackish water from wells is pumped into the tanks with frequent water exchange. Artificial feed is used and production is in the region of 10 kg/m<sup>3</sup>. The PAAFR allocates agricultural

land to interested farmers. The 25-year land lease is renewable and farmers pay a fee of 150 fils/m<sup>2</sup> to the Government (1 000 fils = 1 Kuwait Dinar = 3.44 USD). The Government is presently considering dividing the farms into two categories: category "A farms" producing 6–10 kg/m<sup>3</sup> and, category "B farms" producing below 3 kg/m<sup>3</sup>. The Government currently provides a subsidy to encourage greater productivity and this consists in a free annual allocation of fish feed: 2.7 kg/m<sup>2</sup> of pond area for category "A farms" and, 1.35 kg/m<sup>2</sup> for category "B farms". The subsidized feed meets 50 percent of the farmers' requirements. The remainder is imported. Fish feed is purchased in 25 kg bags, costing the Government USD 0.96/kg. The farmers spend as much as USD 1.37/kg for their additional feed requirements. The feed conversion rate in the category "A farms" is approximately 2:1.

**Intensive fish culture in cages** – The cages used for fish culture were previously square shaped, but are now circular with a diameter of 20 m and 8 m in depth. The annual production target has been fixed at 600 tonnes, which was achieved in 1997. The Government has identified a new site for cage culture at Al-Khiran on the south coast due to algal bloom outbreaks in the Kuwait Bay. Although production has declined, fish culture in cages is continuing through the support of the PAAFR. The Bubiyan Fishing Company, which is involved in fish culture, receives an annual subsidy of KWD 25 000 (1 KWD = 3.44 USD) from the Government.

## SECTOR PERFORMANCE

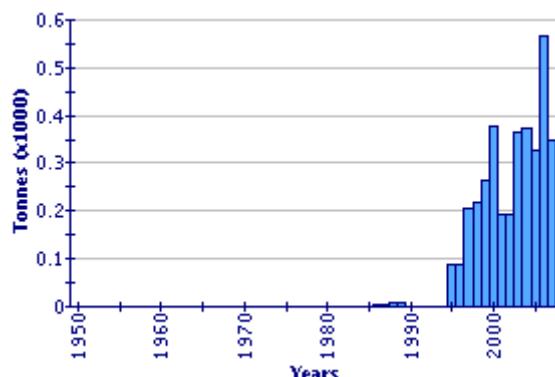
### Production

Aquaculture is now reasonably well-established, as far as the farming of tilapia in association with agriculture, and marine fish culture using floating net cages is concerned. Kuwait aquaculture is economically viable, although fish mortalities in cages during 1999 and 2001 became a serious setback. The annual average production of tilapia from 2005 to 2008 accounts to 327 tonnes.

The Gulf International Aquaculture Company was established in 2003. It commercially produces fish fry, mostly seabream and, to a lesser extent, Sobaity seabream. It purchases fertilized gilthead seabream eggs mainly from France.

The total aquaculture production according to FAO Fishery Statistics data which has been reported from 1950, is as follows:

**Reported aquaculture production in Kuwait**



(Source: FAO Fishery Statistics)

## **Market and trade**

Due to limited production, there is no specific market system for aquaculture products in Kuwait. However, high quality farmed fresh tilapia is sold at USD 3.42–5.13/kg; this relates mainly to farm-gate purchases and sales to restaurants.

## **Contribution to the economy**

Compared to the oil industry in Kuwait, the economic contribution of the fishery and aquaculture industry is very limited. However, as a traditional sector, Kuwait fishery resources supply fresh fish and offer investment opportunities for Kuwait's private sector. The contribution of aquaculture to the national economy is almost insignificant. Aquaculture activities have gained importance in recent years due to technological farming developments, as well as, hatchery systems. The PAAFR has been encouraging aquaculture activities as a matter of priority and production is expected to meet future local demand for fish.

## **PROMOTION AND MANAGEMENT OF THE SECTOR**

### **The institutional framework**

Aquaculture activities are administered and promoted by the Aquaculture division of the Fisheries Department of the PAAFR. The Fisheries Department regulates all aquaculture activities. This includes the identification of suitable fish and allocation of suitable sites to farmers, issuing licences and granting subsidies to farmers and the Bubiyan Fisheries Company. Furthermore, PAAFR adopts rules and regulations for aquaculture development in Kuwait.

### **The governing regulations**

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 established in 1980. In 2005, the PAARF enacted a specific resolution No.293 for aquaculture development in Kuwait, regarding the issuance of aquaculture licences further enabling tilapia and other fish culture to develop. However, the resolution mainly aims at regulating land-based aquaculture activities. In order to encourage more investment in marine cage culture, the PAARF provides yearly subsidies. Furthermore, the following regulatory measures have been adopted under the resolution for aquaculture activities in Kuwait:

- The area of a single fish farm should not exceed 10 percent of the total agriculture farm land, and the area for the fish farm cannot be less than 500 m<sup>2</sup>.
- The fish farm owner should comply with the water quality criteria determined by the department concerned.
- The farmer should have a sufficient source of underground water for fish culture and drained water should be used for agriculture purposes. It is prohibited to drain the fish farm water into low-lying land, public drainage pipes or re-pump the water to the well or transfer outside the agriculture farm.
- Application forms for obtaining a licence must be submitted to the Agriculture Farm Department to assess feasibility. The land identified along with the plan details of the farm should be submitted to the Fisheries Department for verification and approval.
- It is prohibited to introduce new species for culture without prior permission from the Fisheries Department.
- It is prohibited to use any drug, hormone or feed additives without prior permission from the Fisheries Department.

The farm owner should also observe the following conditions:

- The fish tank should be made of concrete, cement or fibreglass.
- Tanks should be constructed at or above ground level to facilitate water drainage.
- Tank depth should not be less than 1 m.
- The farmer must set up a water reservoir tank, air conditioned feed storeroom, electric generator room, drainage pipe system and greenhouse or shelter for the tanks.
- The water storage tank should be up to 3 metres deep; each tank must be provided with a separate water inlet and outlet.
- The farm owner should immediately report any sign of or outbreak of disease to the Fisheries Department.

### **Applied research, education and training**

Research into aquaculture development mainly falls under the responsibility of the KISR. Applied aquaculture research projects, including selection of suitable species, growth studies and disease control are carried out by the Mariculture and Fisheries Department of KISR. These projects are financially supported by the PAAFR, along with other funding agencies.

The Zoology Department of the Kuwait University teaches fisheries science as an optional subject at the undergraduate level. Kuwaiti graduates are encouraged to pursue higher studies at reputable institutions in foreign countries. PAAFR also arranges training programmes and offers technical guidance on fisheries and aquaculture to all stakeholders in association with international organizations and expertise.

### **TRENDS, ISSUES AND DEVELOPMENT**

Aquaculture production represents a wide scope for future development in Kuwait. The country's natural fish stocks are under pressure due to overfishing and capture production has shown a declining trend in recent years. Hence, aquaculture activities are gaining growing support from the Government. Cage aquaculture offers investment and employment opportunities in the future. Recent developments, including the establishment of a marine finfish hatchery facility by the "Gulf International Aquaculture Company" and the Government's tilapia hatchery at Al-Wafra, are potential indicators for future development of aquaculture production in Kuwait. A new site has also been identified on the southern coast of Kuwait where the "Bubiyan Fishing Company" and other companies are likely to establish cages for large-scale marine finfish production. Aquaculture production is expected to meet future demand for fish supplies in Kuwait.

**APPENDIX I****National Aquaculture Sector Overview (NASO) – OMAN**

by

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Oman Aquaculture Centre, Ministry of Fisheries Wealth

(Note: Now moved to the Fishermen Training Institute, Ministry of Manpower)

**CHARACTERISTICS, STRUCTURE AND RESOURCES OF THE SECTOR****Summary**

Aquaculture in the Sultanate of Oman is presently at an early stage of development, both in terms of basic or applied research and private sector growth. The government scripted legislation regarding aquaculture in 2004 and in collaboration with FAO has developed a national strategy for aquaculture development in 2007. Since 1997, the Ministry of Fisheries Wealth has been engaged in seven major research projects on fish and shellfish culture. These included the investigations on abalone hatchery, mussel and oyster culture, shrimp farming and pilot trials on cage and pond culture of finfish. In addition site selection and feed development projects have been successfully completed. At present, three funded programs are ongoing which include: Abalone aquaculture which aimed to develop novel hatchery technologies and to examine the potential of enhancing the natural fishery, Hatchery development for finfish, which concentrates on the breeding and culture technologies for native species including groupers and sea breams; and Sea cucumber aquaculture which investigates the feasibility of artificially producing the seeds and the farming of various species of holothurians while also considering the potential for fishery enhancement and commercial aquaculture production.

Experience gained from Ministry-funded projects and subsequent technology transfer has stimulated entrepreneurial interest in commercial aquaculture ventures. An outcome of this extension exercise has been the establishment of two private aquaculture companies which concentrated on shrimp and finfish production respectively. The shrimp facility has recently completed its second successful harvest and has increased its production capacity with addition of another 100 ha of ponds. Cage culture includes production of gilthead seabream and ranching of yellow fin tuna. Saltwater intrusion along the coastal zone has stimulated interest in the production of tilapia by some small-scale producers. Around twenty applications are presently at various stages of the permitting process. This year, the Ministry of Fisheries Wealth has completed its Environmental Best Management Practices manual which incorporates guidelines for the production of eco-label and organically certified aquaculture products. Also a book titled “Atlas of suitable sites for aquaculture projects in sultanate of Oman” has been recently published which will facilitate aquaculture industries in selecting the right sites for their interested selected species. The role of the Ministry’s Aquaculture Centre in supporting the aquaculture sector growth and the future potential of the industry is very well considered

**History and general overview**

Aquaculture in Oman began in 1986 with a production trial of the giant tiger prawn (*Penaeus monodon*) conducted in a private farm in the Al-Sharqiyah South Region, Sur. However, this venture was halted prematurely by some technical difficulties. As a result, the Government became aware of the sector's need to improve the utilization of the country's natural fishery resources as means of livelihood hence, the establishment of the Aquaculture Laboratory at the Marine Sciences and Fisheries Centre (MSFC). In 1994, research work on broodstock maturation and seed production of the native abalone *Haliotis mariae*, locally known as “a’sufailah”, was initiated at the Mirbat Aquaculture Facility in Dhofar. The result of this experiment was promising (Khalfan etc, 2007). Aquaculture and development research in the Sultanate shall be directed towards developing technologies that benefit most the people who are dependent on coastal fishery resources. One important study conducted by

Aquaculture Laboratory was the identification of sites suitable for aquaculture development which is crucial to the success of commercial aqua-ventures. The Laboratory also conducted a series of experimental trials that dealt with the hatchery and culture of two indigenous shrimp species *Penaeus indicus* and *P. semisulcatus*. A study was conducted on the cage farming of the exotic gilthead seabream (*Sparus aurata*) and a local species, sobaity sea bream (*Acanthopagrus cuvieri*). As the outcomes of these research activities were encouraging, two privately operated commercial cage farms belonging to the Quriyat Aquaculture Company were established. These cage farms produced the gilthead seabream (*Sparus aurata*) as major species and the European seabass (*Dicentrarchus labrax*) and yellowfin seabream (*Acanthopagrus latus*) as minor cultured species. The production of gilthead seabream increased from 331 tonnes in 2003 to 460 tonnes in 2004, while production of European seabass increased from 13 to 27 tonnes. Yellowfin seabream production in 2004 was around 13 tonnes. A further 14 tonnes of the yellowfin tuna (*Thunnus albacares*) were produced through fattening techniques. The total value of aquaculture production increased from USD 1.6 million in 2003 to USD 2.5 million in 2004.

### **Human resources**

Currently, the Ministry of Fisheries Wealth's Aquaculture Centre has five staff members who are directly involved in aquaculture research all of whom are educated in fisheries at graduate and post graduate levels, and four technical support staff with either fisheries and aquaculture background. With the establishment of the new Aquaculture Centre, the number of researchers and technical support staff shall be increased. Human resource development and capacity building are currently being worked out by the Ministry in order to achieve its goals.

### **Cultured species**

The government gives priority to species for aquaculture that are endemic to Omani waters. However, exotic species with high aquaculture potentials are strictly screened for consideration. Current research on the breeding and seed production of grouper *Cephalopholis hemistiktos*, goldlined seabream *Rhabdisargus sarba*, sea cucumber *Holothuria scabra* and the Omani abalone *Haliotis mariae*, carries the objectives of developing the technology and sharing knowledge on the controlled propagation of these four indigenous species. Preliminary results on the commercial farming of these species have shown their best aquaculture potentials. Freshwater carp, *Cyprinus carpio* and the freshwater river prawn, *Macrobrachium rosenbergii* have been introduced recently and are now the subject of experimental investigations dealing with broodstock development, seed production, and grow-out farming techniques. Amongst the species commercially farmed in Oman were introduced species, namely the gilthead seabream (*Sparus aurata*) and the European seabass (*Dicentrarchus labrax*). Gilthead seabream was the subject of research by the aquaculture laboratory in 1997 and proven to be economically viable for marine cage farming. The European seabass and thin lip grey mullet (*Liza ramada*) however, were introduced by the Quriyat Aquaculture Company in 2001. These species were farmed in response to their importance and value on the export market. With assistance from the Government, the company also began to farm two local endemic species, the yellowfin seabream (*Acanthopagrus latus*) and orange-spotted grouper (*Epinephelus coioides*) which were imported from private hatcheries in Kuwait. Experimental trials on the hatchery and grow-out farming of shrimps *Penaeus indicus* and *P. semisulcatus* have been conducted with so much promising results. For freshwater aquaculture, the Nile tilapia (*Oreochromis niloticus*) is now popularly farmed in many areas in Oman. This is in response to a high demand mainly from expatriates living in the country. The tilapia fry were imported from Egypt and Thailand. Small-scale Nile tilapia (*Oreochromis niloticus*) farming is now a widespread activity in different areas of Oman. The majority of the production is consumed locally and valued about 3 USD per kg in local market.

### **Main species of concentration**

There exist a number of species of finfish that are of interest from food and non-food perspectives. Fish of commercial merit include breams and basses, groupers and cobia, as well as mullet,

rabbitfishes and others that are indigenous to Omani waters. Hatchery technologies for many of these species, and or their close relatives, already exist, although in some instances considerable improvements in larval survival are required (e.g. various grouper and cobia). Several ornamental species are of high value and this is especially the case for Omani clownfish, various species of butterfly and angel fish, as well as seahorses. Crustaceans of relevance include the Indian white shrimp and potentially certain species of crab and the indigenous species of edible lobster including the slipper lobster. There may be also one or two species of highly coloured ornamental reef shrimp but this remains an unknown. The native abalone *Haliotis mariae*, is the singularly most important molluscan of concern, mainly due to its apparent scarcity and social and commercial importance. Nevertheless, other species, such as the pearl oyster, mussel and clams may also offer potential for cultivation. Sea cucumbers, sea urchins and perhaps Nereid and lug worms represent other invertebrates that may have latent food and biomedical promise. Freshwater species include the giant river prawn, *Macrobrachium rosenbergii*, which can be polycultured with tilapia (*Oreochromis niloticus*) and common carps *Cyprinus carpio*.

### **Practices/systems of culture**

The main culture systems practised in Oman are the following:

**Shrimp farming** – The shrimp farm owned by Bentoot Seafood Products is located in the Al-Wusta region in the Wilyat Mahout. The Bentoot shrimp farm is presently the only operational facility in the country. The targeted species for culture is the white shrimp *Penaeus indicus*. The site used by the farm, which has an area of 252 000 m<sup>2</sup>, was rented from the Government, commencing 28/09/2005. The company started infrastructure construction in 2006 and farming commenced in early 2007. The first harvest was hauled during the last quarter of 2007. The second harvest was taken in October 2008. The company is presently in the process of expansion which is expected to continue through to 2013. Their current production is between 100 and 150t shrimp per year. The operation also possesses its own hatchery to the east of the facility proper, using an area of approximately 10 000 m<sup>2</sup>. There are 8 levee-based one ha earthen ponds and four ponds of approximately 2 ha surface area.

**Cage culture** – The Quriyat Aquaculture Company is the only privately owned company operating cage culture in the country. It has two cage sites located in the Muscat area, one of 2 400 m<sup>2</sup> and the other 3 500 m<sup>2</sup>. The cages are made of high density polyethylene (HDPE). Sea breams are the main species being cultured.

**Integrated farming systems** – The freshwater culture of Nile tilapia (*Oreochromis niloticus*) is practiced in various areas in Oman, in particular in the northern part of the country. This type of aquaculture is carried out in small farms where high levels of saline groundwater prevent or reduce normal agriculture activities. The tilapia was originally introduced by the Ministry of Health to control mosquitoes. As a result of the adaptability of this species to the environment their numbers increased and local people began to rear tilapia on their farms. There is only one agricultural farm, located in the north of Oman, which produces Nile tilapia on a commercial-scale. Irrigation water is used in the production process. The farm has four concrete ponds each with a volume of 140 m<sup>3</sup>.

**Tuna fattening** – Oman is the first country in the Middle East to have initiated a tuna fattening project. The Quriyat Aquaculture Company has installed one large 47 000 m<sup>3</sup> cage in the Bandar Khayran area for which in 2004 the production was 14 tonnes of yellowfin tuna (*Thunnus albacares*).

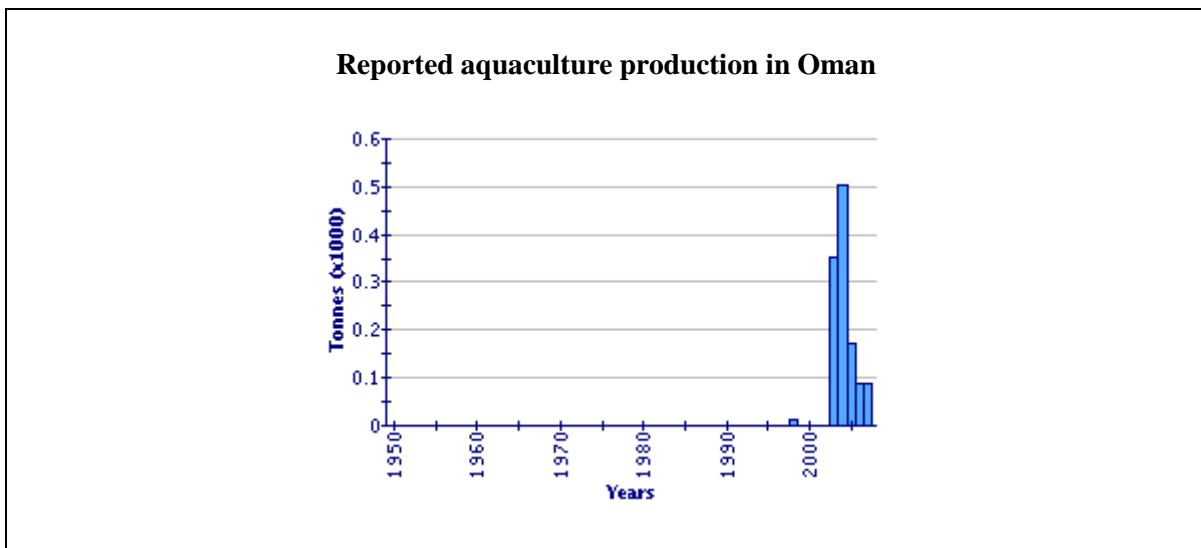
## **SECTOR PERFORMANCE**

### **Production**

Commercial fish production in Oman began in 2003. Total production increased from 352 tonnes in 2003 to 514 tonnes in 2004, with the production of gilthead seabream representing 89 percent of the

total. In 2004, aquaculture production was valued at USD 2.5 million compared to USD 1.5 million in 2003. The gilthead seabream represented about 82 percent of the total production value.

The graph below shows total aquaculture production in Oman according to FAO statistics:



(Source: FAO Fishery Statistics)

### **Market and trade**

The majority of aquaculture production during 2003 and 2004 was exported as whole fish products to the United Arab Emirates with only very minor quantities having been consumed on the domestic market. There were two reasons for this, firstly the relatively high price of aquaculture products and secondly, as a result of the local customer preference in Oman, as it was fresh caught marine fish. The 2004 price of exported gilthead seabream was USD 4.5/kg, while for European seabass was USD 5/kg.

Production from the tuna fattening project was exported directly to Japan. Tuna are headed and gutted prior to being export. Strict quality procedures are applied to the harvesting and packaging process. Exported tuna fetched a price of around USD 20/kg, while tilapia fetch about USD 2.57/kg on the domestic market. Marketing of cultured white shrimp is wide- spread in Oman and other Gulf Cooperation Council Countries. Currently, the annual production reaches 100 tonnes. The local price of cultured shrimp may fetch USD 7–9.

### **Contribution to the economy**

The quantity and value of aquaculture production is still small compared to the contribution from capture fisheries. However, contribution from aquaculture towards the national economy is seen to increase in the nearest future as the sector progresses. Small-scale aquaculture production also contributes in terms of providing livelihood and income for local communities.

## **PROMOTION AND MANAGEMENT OF THE SECTOR**

### **The institutional framework**

The General Directorate of Fisheries Research under the directives of the Ministry of Fisheries Wealth is the lead agency for the development of aquaculture in Oman. This Directorate is responsible for the management of the entire fisheries sector and coordinates relevant issues with all other government departments involved in developing aquaculture. Within the Directorate there are various departments with different responsibility for the management of aquaculture activities.

Aquaculture Centre – This recently established Centre is responsible for conducting scientific research dealing with all aspects of marine and freshwater aquaculture. The Centre also provides scientific and technical advice to the General Directorate of Fisheries in Oman on aquaculture and related topics.

Aquaculture Development Department – This office was established in 2000 within the General Directorate of Fisheries Development following an increase in the level of interest, as well as in the number of applications, received from the private sector regarding investment in aquaculture. Investment proposals are received by the Department and then forwarded to the Aquaculture Laboratory for technical evaluation.

Fish Quality Control Centre – The Centre was established in 1998 to ensure the quality of exported fish. The Centre has a department responsible for ensuring the quality of fish products. A second department is responsible for ensuring that companies comply with existing hygienic and quality assurance norms and regulations including the application of an appropriate HACCP system. Companies wishing to invest in aquaculture are required to obtain a quality control number from the Centre after meeting the conditions outlined in its quality regulations.

Aquaculture Committee – This Committee is responsible for the evaluation of applications received from the private sector, it is chaired by the Director General of Fisheries and is composed of representatives from the Ministry of Agriculture and Fisheries, the Ministry of Regional Municipalities, Environment and Water Resources, the Ministry of Housing, Electricity and Water, the Ministry of Trade and Commerce, the Ministry of Transport and Telecommunications and the Oman Chamber for Commerce and Trade. Other areas of responsibility include the determination of appropriate sites for each application and monitoring the development of the projects.

### **The governing regulations**

The main law governing aquaculture in Oman is the Law of Fishing and Protection of Living Aquatic Resources; this was first issued in 1982, amended in 1993 and is under revision once again in order to reflect current developments in the fisheries sector. The law states that the Directorate General of Fisheries is the competent authority responsible for managing the aquaculture sector. Within the framework of this law there are various executive by-laws issued to enhance its implementation. The two main by-laws relevant to aquaculture, are:

1. The by-law on fish quality control (Ministerial decision No.136/1998).
2. The by-law on aquaculture and quality control of cultured organisms (Ministerial decision No.36/2004).

The executive by-law for aquaculture and quality control of cultured organisms contains around 48 articles on different aspects including licensing, quarantine procedures and quality issues. According to the law, a company cannot undertake aquaculture operations without permission from the competent authority (the General Directorate of Fisheries). Other areas covered by this law include:

- Quarantine procedures and introduction control of exotic species.
- Terms of reference of the Aquaculture Committee and procedures for handling private investment applications.
- Environmental protection and environmental impact assessment (EIA) requirements.
- Quality and hygiene farm requirement regulations.
- Use of feed and drugs (includes list of approved products and treatments).
- Export regulations for aquaculture product.
- Request to land lease.

In addition to the main law of Fishing and Protection of Living Aquatic Resources there are some environmental laws and regulations which relate to the aquaculture sector and which are managed by the Ministry of Regional Municipalities Environment and Water Resources. These include:

- Royal Decree No. 114/2001 issuing the Law on Conservation of the Environment and Prevention of Pollution.
- Ministerial Decision No. 187/2001 organizing the Issuance of Environmental Approvals and the Final Environmental Permit.
- Ministerial Decision No. 7/84 issuing regulations concerning the Disposal of Liquid Effluent to the Marine Environment.
- Royal Decree No. 46/95 issuing the Law of Handling and Use of Chemicals.

### **Applied research, education and training**

The Aquaculture Centre is the state institution responsible for conducting applied and scientific research in the field of aquaculture and related areas. It is also responsible for setting the country's research priorities in aquaculture. Good cooperation in training and research has been established with the only private aquaculture companies currently operating in Oman.

The Ministry of Manpower has recently established a fishermen's Training institute in Al-Khaboura in Al-Batina Region. The institute was opened in 2007. Along with other fisheries specialization It also offers a Diploma with two- years aquaculture courses for high school graduates.. The Department of Marine Sciences and Fisheries at Sultan Qaboos University also offers bachelor, master and post-graduate degree programme in marine sciences and fisheries including aquaculture.

### **TRENDS, ISSUES AND DEVELOPMENT**

The establishment of the Aquaculture Centre by the Ministry of Fisheries Wealth will enable the Omani government to cope up with the expected expansion in the aquaculture sector. The new Centre houses all the necessary research laboratory facilities to ensure that relevant investigations in aquaculture and related fields are carried out for the benefit of the sector.

The National Strategic Plan for Sustainable Aquaculture Development in Oman has also been prepared and published in 2007 by the Aquaculture Centre for the development of the aquaculture sector. The Plan covers areas such as legislation, environmental and disease monitoring, and best practice in sustainable management and development. The Plan furthermore provides guidelines for engaging relevant Government authorities and private sector in the management of the sector.

The main objectives of the Plan are to:

- Promote orderly development of a viable and professionally run aquaculture industry.
- Streamline the approval process of aquaculture investment applications.
- Promote environmental sustainable aquaculture.
- Ensure proper water utilization and control environmental contamination.
- Control the introduction and escapees of introduced aquatic species.
- Control the introduction of pathogens and monitor disease outbreaks.

Sustainable aquaculture in Oman can be achieved through environmentally and socially responsible utilization of the country's natural resources through the cooperation of the private sector. The newly published Code of best practice for the aquaculture sector is seen as an important step forward. The code sets the guidelines on site and species selection, business planning as well as proper farm management. It also serves as the link to the existing government regulations in order to ensure proper interaction with the environment. The Government in fact recognises the importance of an

environmental monitoring programme which includes surveillance, monitoring and reporting systems on aquaculture activities.

Diseases are a major risk in the aquaculture industry and therefore the Ministry of Fisheries Wealth fully understands the importance of a disease prevention plan. Oman is currently free from diseases associated with aquaculture, however the Government intends to invest in the skills and infrastructure necessary in dealing with such circumstances should any problem arise. A disease prevention plan will encourage investments in the sector and reduce the introduction of disease.

More applied research in various areas of aquaculture is still required in order to promote the development of the sector. Future areas of research will likely focus on the (i) selection of local species suitable for aquaculture; (ii) on environmental monitoring; (iii) health and disease control and; (iv) on enhancing the legal and administrative framework.

**APPENDIX J****National Aquaculture Sector Overview (NASO) – QATAR**

by  
**Mohammad Falamarzi**  
 Department of Fisheries, Ministry of Environment

**CHARACTERISTICS, STRUCTURE AND RESOURCES OF THE SECTOR****Summary**

Aquaculture in Qatar is in its early stages. However since 1988, significant efforts to develop the sector have been made. There are a few fish ponds in the private sector using extensive and semi-intensive culture systems. The continuous increase in fish consumption and demand for fish in Qatar needs to be addressed through aquaculture production. The Department of Fisheries is planning new experimental projects for the growth of the aquaculture industries as a profitable venture. The natural resources for aquaculture are yet to be exploited and they require pioneering effort both from government and the private sector. Coast land unavailable for agriculture and commercial activities are available for fish and shrimp culture and associated activities.

**History and general overview**

Aquaculture activity in Qatar started in 1988 with the construction of a small government experimental aquaculture research facility in cooperation with experts from the Japanese International Cooperation Agency (JICA), called the Doha Aquaculture Centre. The centre carries out research on selected species suitable for fish culture according to their price and demand on the local market. Currently the private sector focuses on Nile tilapia (*Oreochromis niloticus*) aquaculture. Most of the private farms are located in south west end of the country.

The Centre started working with the white-spotted spinefoot (*Siganus canaliculatus*), a popular fish in Qatar. The wild fingerlings collected from the sea in March, three months after the spawning season, were reared in an open system for 6–8 months until they reached marketable size of 200 g. Imported artificial feed was used during the rearing period.

In 1998, experiments began in the larvae rearing of both the white spotted spine foot and the yellowfin seabream (*Acanthopagrus latus*) and succeeded in the controlled spawning of the latter species. The hatchery-produced fingerlings were released into the sea for stock enhancement during 1998–2000 and 2002. In 2004, approximately 3 000 green tiger prawn larvae (*Penaeus semisulcatus*) were also produced under controlled conditions and released into the sea.

On an experimental basis, the yellowfin seabream was successfully reared for 18 months. In 2001 a small hatchery unit was established with a seawater treatment system and rotifer production unit. In 2002, a research programme began into improved rearing technology for the larvae of yellowfin seabream, and better results in terms of growth and survival were obtained.

**Human resources**

The current number of people employed in the aquaculture sector is insignificant.

## Farming systems distribution and characteristics

Most of the private farms are small and are located on the south-west coast, following semi-intensive culture methods of Nile tilapia (*Oreochromis niloticus*). Annual production capacity is around 20 tonnes. There is not much commercial culture activity in the country.

### Cultured species

The species cultured in the private sector is the Nile tilapia. Experimental trials have been carried out with the white-spotted spinefoot (*Siganus canaliculatus*), yellowfin seabream (*Acanthopagrus latus*), and the greasy grouper (*Epinephelus tauvina*). The larval production of yellowfin seabream and green tiger prawn (*Penaeus semisulcatus*) was successfully carried out and both species are used in marine stock enhancement programmes.

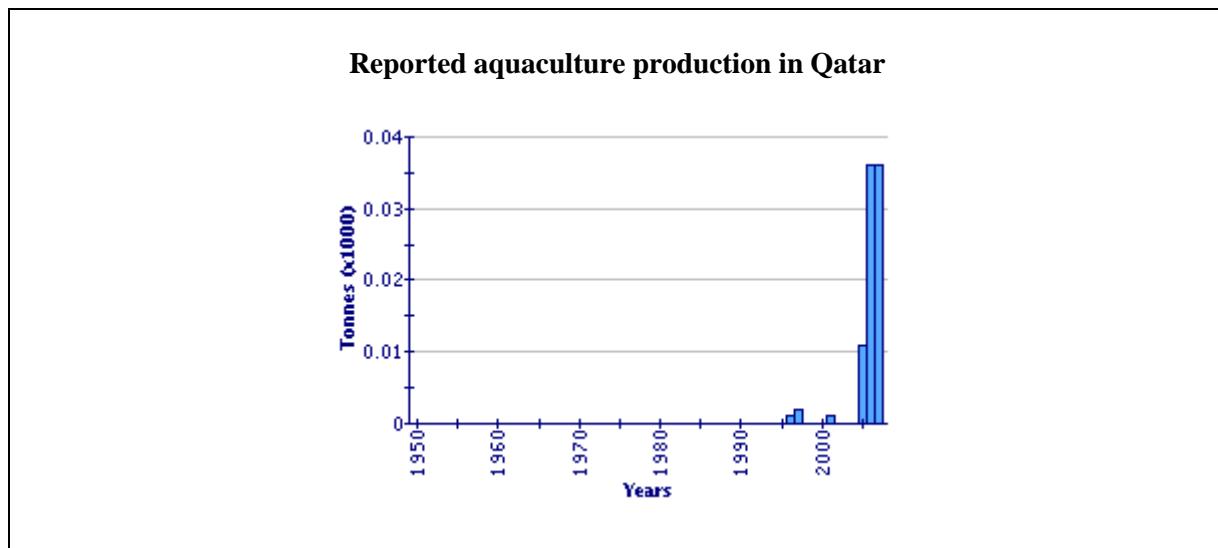
### Practices/systems of culture

As mentioned above, the semi-intensive culture method is practiced by the private sector. Earthen ponds 10 x 20 x 1 m in size and concrete tanks (3 x 10 x 1) are used for farming. The research conducted by the Department of Fisheries into the viability of finfish culture has been found promising. Commercial culture activity is yet to be undertaken with the active participation of private investment.

## SECTOR PERFORMANCE

### Production

The graph below shows total aquaculture production in Qatar according to FAO statistics:



(Source: FAO Fishery Statistics)

### Market and trade

There is no specific market for the sale of aquaculture products due to their limited availability. The produce is sold directly to shopping malls and hotels.

### Contribution to the economy

As the production and income from aquaculture is very low, there is no significant impact on the economy. The fish requirements of the country are met mostly from marine catch and imports.

## **PROMOTION AND MANAGEMENT OF THE SECTOR**

### **The institutional framework**

The governing agency for fisheries and aquaculture is the Department of Fisheries under the Ministry of Environment, and headed by the Director of Fisheries. Aquaculture activities are under the responsibility of the Aquaculture Unit of Fisheries Development Division within the Department. This division regulates all aquaculture, stock enhancement and conservation programmes in the country. The staff that works in the Department includes professionals, technical and support personnel. Special emphasis is being given to engage more staff in the aquaculture sector for its pilot project at Al-Khor. The Department takes all available opportunities to train and educate its personnel by participating in national and international fora, exhibitions and symposiums.

### **The governing regulations**

There are no regulations for aquaculture, but there are common aquaculture rules and regulations for aquaculture activities in the Gulf Cooperation Council (GCC). Many of these regulations are however still under review and discussion between the GCC countries.

### **Applied research, education and training**

Research and training are the responsibility of the Department of Fisheries, mainly for site selection, identifying suitable species, growth studies, controlled larval rearing, disease control and management. The premier educational institution, Qatar University, offers a graduate level course in Marine Science to impart scientific and technical knowledge in this field to the coming generation.

## **TRENDS, ISSUES AND DEVELOPMENT**

For many years the Department of Fisheries attached great importance on the national marine resources through research into fish stock assessment and aquaculture activities. In order to develop sustainable aquaculture, the Department recently proposed the construction of its first Marine Resources Research Centre at Rasmuthback, north of Al-Khor.

## National Aquaculture Sector Overview (NASO) – SAUDI ARABIA

by  
**Anwar Essa Al-Sunaiher**  
 Aquaculture Department, Ministry of Agriculture

### CHARACTERISTICS, STRUCTURE AND RESOURCES OF THE SECTOR

#### Summary

The Kingdom of Saudi Arabia occupies 80 percent of the Arabian Peninsula land surface with a unique geographical location, with the length of its coastal belt along the Red Sea and the Gulf exceeding 2 400 km. This makes the country a rich source of a wide range of fish and other marine products suitable for commercial exportation, particularly marine species, attributed to favourable climate conditions, availability of water, good land and suitable environment. Due to the excellent potential favourable environment for fish farming, the Ministry of Agriculture has identified aquaculture as a priority economic sector, as a result of rich finfish and shellfish resources, some of which have been identified as suitable aquaculture candidates.

Aquaculture in Saudi Arabia is rather a new activity. First aquaculture experiences date back to the early 1980s when Nile tilapia was reared in inland water bodies. In 2000 the sector started to move toward shrimp aquaculture giant tiger prawn first and Indian white shrimp after. To date, the shrimp aquaculture industry is highly developed, with a current production of 8 705 tonnes in 2004, a significant increase from just one tonne in 1987 (Fisheries Statistics, 2008).

Whereas the bulk of freshwater aquaculture production is consumed locally, the shrimp production is exported in many countries like Japan, European and North American markets, once the domestic demand has been satisfied. There has been a rapid development of aquaculture in the last 5 years, as perceived from the rapid increase in the number of fish farms during this period. The development is towards increased production of white shrimp and diversification towards the culture of marine fish species. This trend is expected to continue in the coming years.

#### History and general overview

Aquaculture in the Kingdom of Saudi Arabia is relatively new sector. It began during the early 1980s when some farmers started culturing tilapia in freshwater bodies in inland areas. Nile tilapia (*Oreochromis niloticus*) has been the major fish produced in aquaculture until 2000, when shrimp began to be produced in large quantities. Initially, the activities on shrimp culture were mainly on giant tiger prawn (*Penaeus monodon*) where the breeding and culture technologies developed in Southeast Asia were brought to Saudi Arabia. However, because of the high saline waters around the country, *P. monodon* culture was not successful. Instead, it was replaced by the Indian white shrimp (*Penaeus indicus*), which was found to survive and grow well in the high saline waters around the country.

Over the past few years, special attention has been directed at boosting commercial aquaculture production. Feasibility studies concerning aquaculture operations demonstrated the economic importance of investing in different aspects of this sector. Compared to other investment activities, aquaculture is a relatively new field, however, considered economically important and a sector attractive to foreign investment. The Ministry of Agriculture strongly supports and encourages investment by facilitating the acquisition of project land, as well as, providing favourable loans. Experimental and show-case aquaculture projects have been established by the authorities to encourage local and foreign investments.

The Ministry of Agriculture is especially focused on the activities and development of the aquaculture sector, so as to meet local needs and for the purpose of exports from such an important source of animal protein. Aquaculture projects in Saudi Arabia are either inland projects, established within agriculture projects or close to them, or coastal projects located along the Red Sea coast. The Department of Aquaculture is responsible for issuing licenses, for setting-up operations for aquaculture projects after the evaluation of feasibility studies for these projects.

The first aquaculture farm in Saudi Arabia was established a little over two decades ago when the first license to operate this kind of business venture was granted in 1983. During this time, freshwater aquaculture was the main activity producing largely Tilapia. There were less than 20 fish farms in Saudi Arabia during the 80s until the early 90s. The number of fish farms increased significantly to 109 in 2002 (Statistical Indicators for Fisheries in Saudi Arabia, 2002) and more than doubled in just 2 years to 227 in 2008 (Fisheries and Aquaculture Statistics, 2008). From a mainly freshwater aquaculture-oriented activity, it became a highly successful marine aquaculture venture as well, largely producing white shrimp. At present it can be said that aquaculture is both freshwater and marine, but dominated by only two aquaculture commodities, Tilapia for freshwater and white shrimp for marine aquaculture. Because of this dependence on two aquaculture species, farmers are now starting to diversify their aquaculture operations into marine fish culture.

### **Human resources**

In 2003, the employment in the aquaculture sector reached 3 407 full time jobs (Fisheries Statistics, 2006). This figure is expected to increase because of the increasing number of farms in the past 2–3 years. Many of these workers, especially those working in the farm sites are unskilled workers doing routine maintenance labour. A few highly-skilled people are in-charge of the operation of the farms. Most of the skilled workers employed in the industry are non-Saudi nationals. It should be noted, that at present, no women are part of the working force in the industry.

### **Farming systems distribution and characteristics**

Freshwater sources are limited in Saudi Arabia and the main source of water is underground water, which is used both for aquaculture and agriculture. Therefore, freshwater farms are distributed all around the country where source of water is accessible. The only way to establish a freshwater fish farm is to set up a traditional crop farm with the effluent water being used to irrigate crops. Consequently, fish farming and agricultural activities are joint activities. This system is beneficial for both fish health and agricultural production.

Brackish and marine aquaculture is mainly undertaken in huge shrimp farms using ponds and raceways located along the Red Sea cost.

### **Cultured species**

Many species of freshwater, marine fish, shrimps, shellfish and ornamental fish are suitable for aquaculture activities. These species include:

**Shrimps** – Mainly the white shrimp, *P. indicus*, constitute the bulk of the aquaculture production in the country, comprising of about 78 percent of the total aquaculture production in 2004 (Fisheries Statistics, 2008). This species is present in the waters around Saudi Arabia and is tolerant to high water salinity. Because of its capability to breed and grow well in high saline waters, this species was found to be the best shrimp species suitable for aquaculture in the country. There were early attempts to culture *P. monodon* and *P. semisulcatus*, but failed due to water salinity issues.

**Tilapia** – Nile tilapia (*Oreochromis niloticus*) is the main freshwater fish cultured in the country with present production of 2 276 tonnes or about 20 percent of the total aquaculture production in 2004 (Fisheries Statistics, 2006). These are mainly cultured in inland waters, where the freshwater used is also used for agricultural crops irrigation. In the last 10 years, *Oreochromis spilurus*, a salt tolerant strain of tilapia was introduced from Kenya. This species is now bred and cultured in high saline waters of the Red Sea. The present production of *O. spilurus* is still very minimal at about 1 percent of the total aquaculture production in 2004 (Fisheries Statistics, 2008).

**Other species** – Other species of fish that have consistently registered an annual production for the last 5–10 years are North Africa catfish (*Clarias gariepinus*), rabbitfish or siganids (*Siganus rivulatus*) and flathead grey mullet (*Mugil cephalus*). The production of these species, however, is still very low.

### Practices/systems of culture

Several fish farming systems are currently used for fish and shrimp production. These systems vary depending on technical, operating and productive capacity. The systems used are extensive, semi-extensive, cage culture and pen culture.

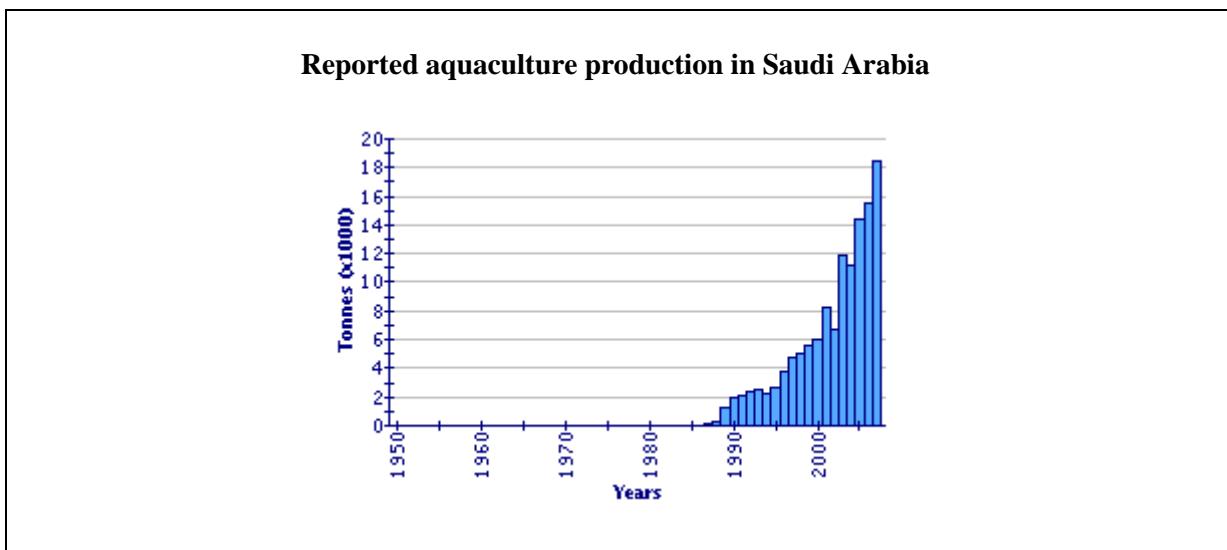
Tilapia farms employ the semi-intensive culture system. Most of the farms produced their own fry and fingerlings for stocking in grow-out ponds or tanks. The main source of water is from a well. Water is changed once a week and waste pond water is recycled after staying for some time in a settling pond. During the exchange of water, 50 percent of new well water and another of recycled water is introduced. Artificial feeds from commercial feed companies are used and some farmers produced their own feeds. Similarly for shrimp culture, the semi-intensive method is largely used. The size of the culture ponds is large, ranging from 1 hectare to 10 hectares per compartment. Stocking density in grow-out ponds ranges from 15–25 pcs/m<sup>3</sup>. Approximately, 15–20 percent of water is changed daily.

## SECTOR PERFORMANCE

### Production

In 2004, aquaculture production comprised about 17 percent (11 172 tonnes) of the total fish production (66 591 tonnes) in Saudi Arabia. Production in freshwater culture systems was 2 306 tonnes or 20 percent of the total aquaculture production, whereas production in seawater culture systems was 8 866 tonnes or 80 percent (Fishery Statistics, 2008).

The graph below shows total aquaculture production in Saudi Arabia according to FAO statistics:



## **Market and trade**

The majority of fish production in freshwater systems, mainly tilapia and catfish, are sold in the domestic market either live or in fresh form. The local marketing chain is very well established. Selling is done by whole sale in the farm site and the products are distributed to a chain of retail shops around the country. The transport of live fish to the market is done using vehicles equipped to keep the fish alive. Trade of live fish is lucrative since the market price is twice than that of the fresh fish.

Shrimps produced in the country are also sold outside. Export markets include Asia (Japan, Korea Rep. And Hong Kong SAR), Australia, Europe, United States of America, other Arab countries like Egypt. The price is regulated by the demand and the production capacity.

Although fish occupies minor importance in the diet of Saudi people, the demand for fresh fish for human consumption in the country is growing. The annual per capita fish consumption has increased from 3 kg in 1977 to almost 8 kg in 2003 (Fisheries Statistics, 2003). The current fish supply from the country cannot meet the growing demand and this has spurred the aquaculture industry to increase production.

## **Contribution to the economy**

Because aquaculture is relatively new in Saudi Arabia, its contribution to the national economy is not yet significant. Nevertheless, the commercial and economic importance of aquaculture so far can be summarized as follows:

- The annual investment income for aquaculture projects is relatively high reaching 20 percent.
- The production of fresh, safe and highly valuable animal protein for local consumption and for export.
- The production plan is not defined by specific seasons or standards, but it is linked to the consumer and marketing.
- The quality and quantity of production is controlled by market needs, consumer requirements and exports.
- Saudi Arabia is located close to European markets which are considered one of the most important consumer markets for seafood products, in addition to the availability of recent means of communication and governmental support to cargo services.
- The availability of research programmes and field experimental studies with respect to local fish and shrimp species, aquaculture systems and feed production.
- Providing jobs for an important sector of national qualified personnel.
- Strengthening the contribution of the agricultural sector in the national economy.

## **PROMOTION AND MANAGEMENT OF THE SECTOR**

### **The institutional framework**

The main agency tasked to regulate and supervise aquaculture development in Saudi Arabia is the Department of Aquaculture (DA), an agency under the Office of the Deputy Ministry of Fisheries Affairs within the Ministry of Agriculture (MOA). Based in the capital city of Riyadh, the main task of the department is to control, regulate and supervise aquaculture operations in coastal and inland regions, as well as, to support research projects which focus on aquaculture and suitable fish and shrimp species for fish farming purposes in fresh and marine waters. The DA has the following objectives and specifications:

- Supporting and supervising activities dealing with site selection of coastal areas suitable for setting up aquaculture projects.
- Design and approval of short and long-term plans for updating current and future aquaculture performance in Saudi Arabia.

- Periodical revision of aquaculture production plans.
- Market analysis of aquaculture products, identification of critical marketing problems facing investors and proper means of correction.

### **The governing regulations**

Because aquaculture is relatively new in the country, there are not many rules and regulations governing the sector. The law regulating fishing, investment and protection of living aquatic fisheries resources has been issued by the Royal Decree (No. M/9) on 18 November 1987, entrusting the MOA, the responsibility of regulating fishing, investment and protection of living aquatic fisheries resources in Saudi Arabia. The MOA supervises the development of this sector through the Deputy Ministry of Fisheries Affairs by the General Directorate of Aquaculture Department that plays a key role in establishing general policies, planning and designing long and short-term programmes for the development of fish resources and staffing for inland and coastal aquaculture development in the country.

### **Applied research, education and training**

The collaboration between the government, academies, research institutions and the private sector, has helped to develop aquaculture in Saudi Arabia. Early research activities on aquaculture were done by the Fish Culture Centre of the Saudi Arabian National Centre for Science and Technology now King Abdul Aziz City for Science and Technology, a government agency tasked to promote scientific research and technology development in the Kingdom. This agency maintains a centre for freshwater culture. Seeing the potential of aquaculture as a means to provide food fish for the local people, the government established research centres to hasten the development of the sector. These research centres are the Fish Farming Centre in Jeddah, Fisheries Research Centre in the Eastern Province and Fisheries Research Centre in the Red Sea. Soon to be operational are the Fish Health and Safety Laboratories in Jeddah and Dammam. There are a number of universities that are offering courses on Fisheries and Aquaculture and the graduates from these universities find their way to work in the different research centres and the private farms around the country.

At present, aquaculture research and training is done mainly in the Fish Farming Centre (FFC) in Jeddah. The focus of research in FFC is mainly on marine fish species. Very little aquaculture research is done elsewhere in the country. Grants for scientific research studies come mainly from the government and is administered by King Abdulaziz City for Science and Technology. There is no vocational training on aquaculture in technical or vocational colleges.

### **Fisheries Research Centres**

The Deputy Minister of Fisheries Affairs supervises several fisheries research centres in Saudi Arabia. These centres provide technical and extension services to the local aquaculture projects based on scientific and research studies.

The research centres are:

- Fish Farming Centre in Jeddah.
- Fisheries Research Centre located in the eastern province.
- Fisheries Research Centre in the Red Sea.
- Fish Health & Safety Labs in Jeddah and Dammam (under process).

### **Fish Farming Centre in Jeddah**

The fish farming centre in Jeddah was established in 1982, under an agreement between FAO and the Saudi Arabian government. The main targets of the centre are to focus on research and development programmes for marine fish and shrimp species suitable for fish farming operations, transfer and

application of recent aquaculture techniques and training programmes. The centre lies on the Saudi Arabian Red Sea coast, 60 km north of Jeddah. It has been carefully selected to fit the establishment of models for different fish farming systems, e.g. cages, pens and ponds, as well as, other accessory facilities. The centre has the following objectives:

- Conduct of research programmes to select valuable local and foreign marine fish and shrimp species suitable for fish farming at commercial level under local environmental conditions of Saudi Arabia.
- Evaluate different means of fish farming systems and select those suitable for application in different regions.
- Develop standard fish and shrimp feed formula using locally available components.
- Conduct field and research studies in diseases of cultured fish and shrimp species.
- Execute quality control of water drainage from fish farms.
- Carry-out training programmes covering different aspects of aquaculture operations.
- Provide aquaculture projects with the required fish and shrimp larvae and fingerlings.
- Publish and distribute free extension books which cover all aspects of aquaculture operational techniques and offering technical extension to aquaculture projects.
- Selection of suitable coastal areas for aquaculture projects.
- Evaluate feasibility studies of aquaculture projects.
- Support the centre library with recent references of aquaculture operations.

## **TRENDS, ISSUES AND DEVELOPMENT**

As stated earlier, the shrimp aquaculture industry is developing very fast. This is expected to continue in the next 10 years as evidenced by the increasing number of farms that applied licenses to operate shrimp farms. In addition, the existing big shrimp farms are also expanding, acquiring more areas intended for production.

The big shrimp farms are also diversifying their aquaculture operations. In the pipeline are plans to go into marine fish culture, especially the highly priced marine fish species such as groupers, seabreams and seabass reared in floating cages in the Red Sea.

**APPENDIX L****National Aquaculture Sector Overview (NASO) – UNITED ARAB EMIRATES**

by  
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**CHARACTERISTICS, STRUCTURE AND RESOURCES OF THE SECTOR****Summary**

The United Arab Emirates (UAE) is one of the pioneers in aquaculture among the countries of the Gulf Cooperation Council (the GCC was founded in 1981 and includes Saudi Arabia, Kuwait, Bahrain, Qatar, and the Sultanate of Oman). The country is endowed with many natural lagoons, bays and creeks, most of which are encircled by mangrove swamps providing ideal spawning and nursery grounds for a wide variety of fish and shrimp species.

With a view to utilizing this natural environment for the development of fisheries, the Ministry of Environment and Water (MOEW) established the Marine Environment Research Centre (MERC) in Umm Al-Qaiwain on the west coast of UAE in 1984. Aquaculture is one of the main developmental activities undertaken by the MERC since its inception. Fingerlings of locally popular fish species such as white-spotted spinefoot (*Siganus canaliculatus*), orange-spotted grouper (*Epinephelus coioides*), large-scale mullet (*Liza macrolepis*) and Sobaity seabream (*Sparidentex hasta*) are produced during their natural spawning season at this experimental research station.

In compliance with the policy of the Government, a major part of the fingerlings produced at MERC is released at suitable locations along the coastal waters of UAE.

The MERC retains in its facilities tilapia broodstock. The fry and fingerlings produced under natural conditions are widely distributed to all interested fish farmers for on-growing.

Commercial scale aquaculture using sea net cage is being carried out off Dibba on the eastern coast of UAE, facing the Gulf of Oman. Although a number of fish species have been tried since 1999, the main species currently cultured in these facilities are the Gilthead seabream (*Sparus aurata*), the European seabass (*Dicentrarchus labrax*) and the Sobaity seabream (*Sparidentex hasta*). Commercial size fish harvested from these cages are for the local and international market.

The MOEW has been promoting aquaculture by offering fingerlings and imparting technical know-how to those who are interested. The environmental conditions in the country are favourable for aquaculture projects and the authorities hope to attract more investors in the coming years.

**History and general overview**

Aquaculture activities in UAE started with the establishment of the Marine Environment Research Centre (MERC) in 1984. The Centre was initially supported with the technical co-operation from the Japan International Co-operation Agency (JICA). The role of the MERC includes conservation, replenishment and development of marine resources in the territorial waters of the country. Between 1985 and 1996, regionally important marine finfish species such as the white-spotted spinefoot (*Siganus canaliculatus*) and the orange-spotted grouper (*Epinephelus coioides*) were selected for fingerling production. Subsequently from 1997 to 2000 the following seabream species, *Rhabdosargus sarba* and *Acanthopagrus latus*, were also cultured. Fingerling production of the Sobaity seabream (*Sparidentex hasta*) and large-scale mullet (*Liza macrolepis*), started in 2001 and 2003, respectively. The International Fish Farming Company (Asmak) started the first commercial cage culture farm in

1999 and Mubarak fisheries is the second. There are other big investments coming though private sector, one being the first UAE Caviar Farm, that will be producing Sturgeon for the caviar and Meat for the first time in UAE and biggest in GCC.

The MERC has been producing post larvae of the locally predominant shrimp species *Penaeus semisulcatus* and *Penaeus indicus* since 1985, raising them to adult size. Shrimp culture was temporarily halted in 2001. The release of fish fingerlings produced annually at the Centre makes a partial contribution to compensate for the loss due to exploitation by the capture fishery sector. Other than this MOEW had also been doing experiments on coral reefs restoration through culturing and transplanting.

The MERC has also been providing the necessary assistance for establishing aquaculture facilities in the private sector in UAE.

Freshwater aquaculture in UAE is confined to a few irrigation channels, ponds and tanks adjacent to agriculture farms. There is a surge in interest in the rearing of tilapia in such facilities as it provides dual benefits by fertilizing the irrigation water while producing farmed fish.

### **Human resources**

The 2008 records of the Ministry of Environment and Water indicate that the UAE has a fishing force of about 20 649 and an estimated total annual catch of 74 075 tonnes. Since aquaculture in the UAE is still in its infancy, the workforce engaged in aquaculture activities is limited compared to other fields of the industry. The workforce employed in the various aquaculture activities consists entirely of men, with the presence of skilled workers, graduates and post-graduates. The total staff in commercial aquaculture of 46 persons.

### **Farming systems distribution and characteristics**

The Marine Environment Research Centre is well located and occupies a land area of 127 000 m<sup>2</sup> (latitude 25° 30' north; longitude 55° 30' east) on the western side of the main sea channel of the Umm Al-Qaiwain Lagoon. The facilities available at the Centre include four culture ponds, each with a capacity of approximately 2 500 m<sup>3</sup>, six 100 m<sup>3</sup> larvae rearing tanks, five 50 m<sup>3</sup> broodstock tanks, twenty six 8 m<sup>3</sup> and ten 5 m<sup>3</sup> fibreglass tanks for the culture of algae and other micro-organisms.

The existing finfish cage culture project is located in the sea off Dibba (latitude 25° 37' north; longitude 56° 15' east) on the east coast of UAE.

### **Cultured species**

The main species currently selected for aquaculture purposes at the MERC are the white-spotted spinefoot (*Siganus canaliculatus*), the Sobaity seabream (*Sparidentex hasta*) and the orange-spotted grouper (*Epinephelus coioides*). The finfish species commercially cultured in the Dibba cages is the gilthead seabream (*Sparus aurata*).

### **Practices/systems of culture**

At the MERC, fish larvae are produced either through natural or induced spawning. The larvae are then reared to fingerling size in 100 m<sup>3</sup> tanks and later transferred for grow out in ponds. A series of research activities is being conducted to stock the larvae for further rearing directly in larger culture ponds of 2 500 m<sup>3</sup>. The results achieved so far have been encouraging, probably as a result of better environmental conditions prevailing under pond culture. A large number of fingerlings are released annually to the sea under a sponsored governmental policy.

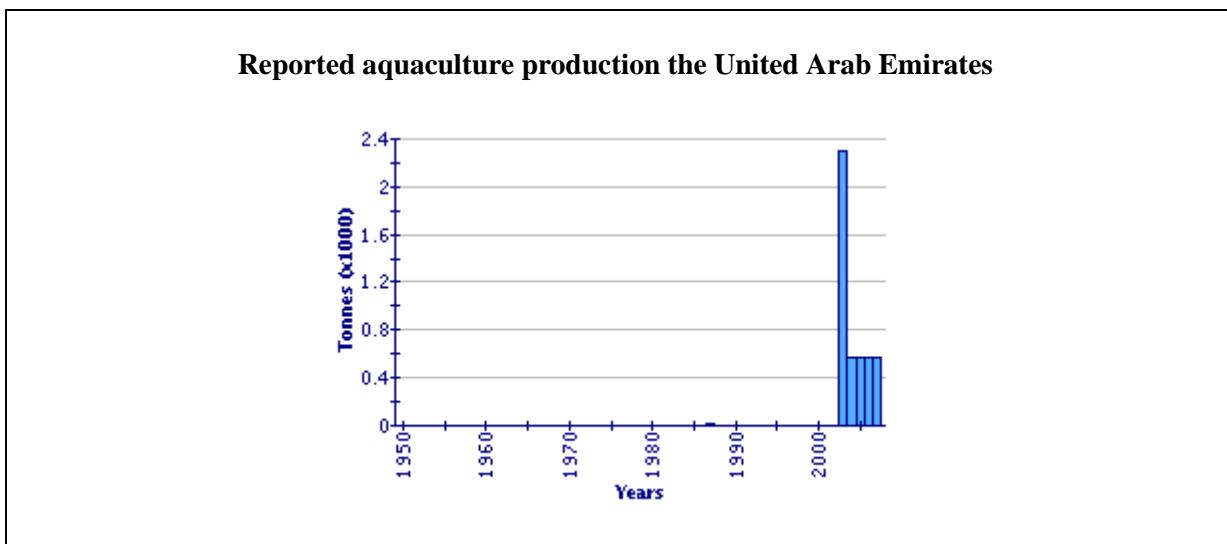
In the cage culture project at Dibba, fingerlings are stocked in cages and farmed to commercial sizes. In general, the hydrographical conditions along the east coast of UAE are favourable for commercial aquaculture. At present about 5 circular sea net cages measuring 19 metres in diameter (depth: 12 metres). The nearest cage is located approximately 1.5 km off the coast of Dibba.

## SECTOR PERFORMANCE

### Production

The fish fingerling production target at the MERC in 2010 was about 130000 for the following finfish species: Sobaity seabream (*Sparidentex hasta*), white-spotted spinefoot (*Siganus canaliculatus*) locally known as “safi” and the orange-spotted grouper (*Epinephelus coioides*) locally called “Hamoor” .

The graph below shows total aquaculture production in United Arab Emirates according to FAO statistics:



(Source: FAO Fishery Statistics)

### Market and trade

There are numerous fresh fish markets built with modern amenities located in different cities, villages and in some of the main fish landing facilities in the UAE. The well developed road network in the country ensures rapid transportation of the fish to the markets ensuring that quality and freshness are retained.

Fish harvested from the cage nets in Dibba are mainly for local market.

### Contribution to the economy

UAE has achieved food security in the availability of fresh fish. The Government feels that the annual restocking fish fingerling programme into the sea is making a contribution to the wild fish stock of the region, which indirectly helps the economy. In addition, the export of fish through private enterprises is contributing to the country's economy.

## PROMOTION AND MANAGEMENT OF THE SECTOR

### The institutional framework

The Ministry of Environment and Water (MOEW), headed by a Minister, General Manager, and the Executive Managers, is the supreme authority that controls the fisheries and aquaculture sectors in the

UAE. There are two main Departments in the Ministry, the Marine Environment Research Centre Department and the Fisheries Department.

### **The governing regulations**

During 1999, the Ministry of Environment and water, introduced the Federal Law No.23 regarding the exploitation, protection and development of the living aquatic resources in the waters of the United Arab Emirates. This is a comprehensive regulation governing many aspects concerning fisheries, fishing activities, coastal zone management, marine resource and environmental protection, conservation of endangered marine species and coral reef areas. Aquaculture activities are also covered by this law under Articles 34 to 38 (Reference No.7, Section 2.5). Accordingly, firms engaged in aquaculture should not cause pollution to the environment, are not allowed to introduce alien species without prior permission from the Ministry and should follow recognized hygienic procedures in handling, stocking, packing and transportation of fish.

### **Applied research, education and training**

Since its early days, the MERC has been carrying out experimental studies on selected marine finfish species. Fingerlings produced through aquaculture at the Centre are used for most of these experiments. Some of the research activities include (i) growth and survival rates of fingerlings fed with different kinds of feeds; (ii) optimum protein ratios for maximum growth and best feed utilization of white-spotted spinefoot fingerlings; (iii) effect of dietary fibre and dietary fat levels on the growth of white-spotted spinefoot; and (iv) growth rate of cultured fish in growout ponds. The results of these studies are regularly published in scientific papers and circulated to interested parties.

## **TRENDS, ISSUES AND DEVELOPMENT**

The MERC was established by the Ministry of Environment and Water in 1984 in order to boost fisheries development in the country. One of the main priorities of the MERC is the development of aquaculture, involving such diverse issues as conservation, replenishment and development of the marine resources of the UAE, research and experimental trials in species and culture practices. Another instance of the importance given to sustainable aquaculture is the requirement that the major portion of the fingerlings produced at MERC is released at suitable locations along the UAE coastline. There has been an increase in the fish fingerling production at MERC during the last few years and, correspondingly, a progressive increase in the number of fish released in the wild. This is a part of the government's efforts to maintain sustainable fisheries regionally and is expected to fetch positive results in the future.

Freshwater aquaculture is limited to a few irrigation channels, ponds and tanks adjacent to agriculture farms. Expansion is likely in the future as people are becoming aware of the dual benefits of rearing fish such as tilapia in such facilities which will not only produce fish but also fertilize the irrigation water.

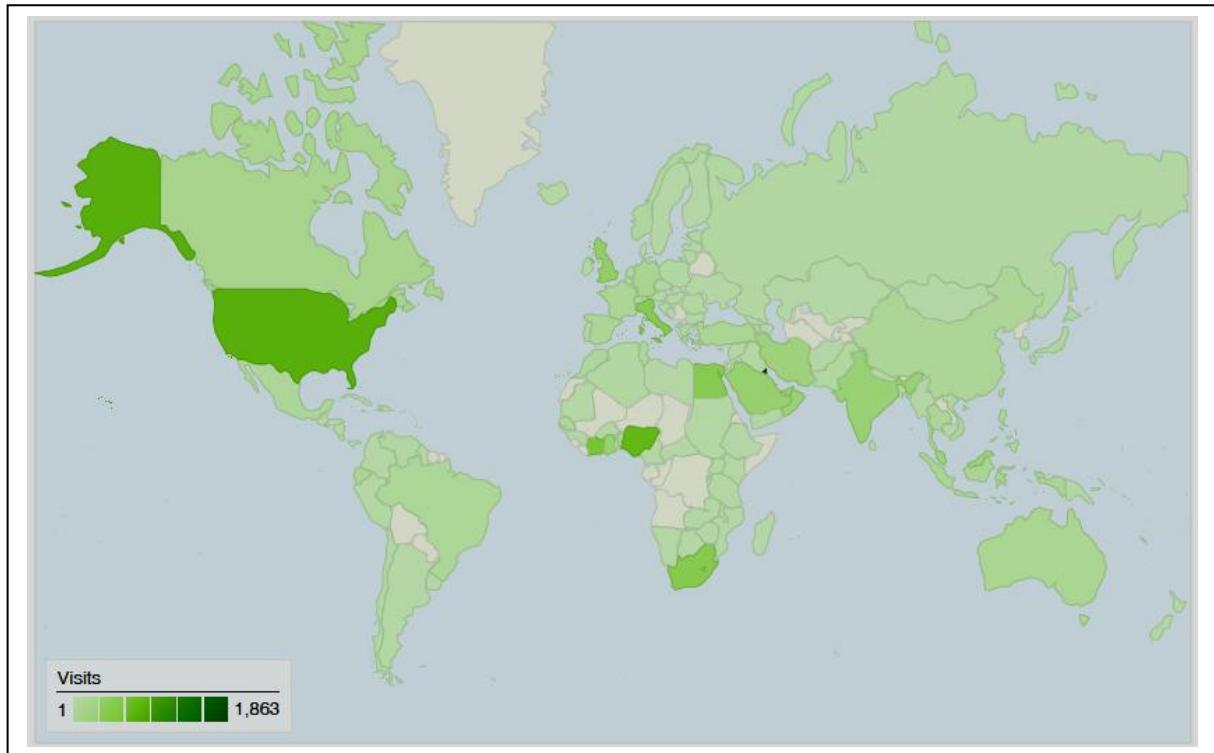
Finfish cage culture has a recent history having started in 1999 by a private company, with a production of 1 206 tonnes in 2008. Assessments indicate that the hydrographical conditions along the eastern coast of UAE are favourable for commercial aquaculture so it is possible that this sector may expand in the future.



**APPENDIX M****RAIS Web analysis summary report**

**Top Traffic Sources**

Sources	Visits	% visits	Keywords	Visits	% visits
google (organic)	3,962	37.14%	regional aquaculture	56	1.29%
(direct) ((none))	2,494	23.38%	www.raisaquaculture.net	50	1.15%
moe.edu.kw (referral)	1,560	14.62%	rais	49	1.13%
globefish.org (referral)	289	2.71%	rais aquaculture	35	0.81%
fao.org (referral)	223	2.09%	fao glossary	24	0.55%



Site Usage					
Visits <b>10,659</b> % of Site Total: 100.00%	Pages/Visit <b>4.46</b> Site Avg: 4.46 (0.00%)	Avg. Time on Site <b>00:03:09</b> Site Avg: 00:03:09 (0.00%)	% New Visits <b>74.21%</b> Site Avg: 73.99% (0.29%)	Bounce Rate <b>59.63%</b> Site Avg: 59.63% (0.00%)	
Country/Territory	Visits	Pages/Visit	Avg. Time on Site	% New Visits	Bounce Rate
Kuwait	<b>1,863</b>	3.90	00:02:18	81.48%	57.97%
United States	<b>811</b>	4.20	00:02:08	65.10%	62.52%
Nigeria	<b>729</b>	1.32	00:01:18	77.09%	86.69%
Côte d'Ivoire	<b>584</b>	2.04	00:01:49	66.44%	82.19%
South Africa	<b>450</b>	2.51	00:01:59	58.00%	82.22%
Italy	<b>436</b>	6.55	00:04:47	55.73%	39.91%
Egypt	<b>430</b>	3.69	00:02:26	88.84%	62.56%
Bahrain	<b>335</b>	8.61	00:06:17	53.43%	37.91%
United Kingdom	<b>320</b>	4.24	00:02:45	75.31%	56.56%
Saudi Arabia	<b>279</b>	9.50	00:07:08	80.65%	47.67%

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**APPENDIX N****National RECOFI-WGA Focal Points and Alternate Focal Points**

(Update 27 October 2010)

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**APPENDIX O****RECOFI Publications**

(2008 to present)

**RECOFI Publications**

Stamatopoulos, C. Improving the utility and diffusion of fisheries statistical data among RECOFI Members. Regional Commission for Fisheries, FAO Regional Office for the Near East, Cairo. 2008. 56p.

FAO/Regional Commission for Fisheries. Report of the Regional Technical Workshop on Aquatic Animal Health. Jeddah, Kingdom of Saudi Arabia, 6–10 April 2008. *FAO Fisheries and Aquaculture Report*. No. 876. Rome, FAO. 2008. 119p.

FAO. Report of the Second Session of the RECOFI Working Group on Fisheries Management. Cairo, Egypt, 27–30 October 2008. *FAO Fisheries and Aquaculture Report*. No. 889. Cairo, FAO. 2009. 65p.

Regional Commission for Fisheries. Trends and Pattern of RECOFI Capture Fisheries Production (1986–2006). FAO Regional Office for the Near East. CD-Rom prepared for and presented at the Second Session of the RECOFI Working Group on Fisheries Management, 27–30 October 2008, Cairo, Egypt.

FAO/Regional Commission for Fisheries. RAIS – Regional Aquaculture Information System. User Manual. Version 1.0. Rome, FAO. 2009. 52p. [Bilingual version English/Arabic].

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.

FAO/Regional Commission for Fisheries. Report of the fourth meeting of the Working Group on Aquaculture. Muscat, Sultanate of Oman, 27–28 January 2009. *FAO Fisheries and Aquaculture Report*. No. 895. Rome, FAO. 2009. 44p.

FAO/Regional Commission for Fisheries. Report of the FAO/RECOFI Workshop on Illegal, Unreported and Unregulated Fishing. Muscat, Sultanate of Oman, 30 March – 2 April 2009. *FAO Fisheries and Aquaculture Report*. No. 903. Cairo, FAO. 2009. 30p.

FAO. Regional Office for the Near East and North Africa. Report of the fifth session of the Regional Commission for Fisheries. Dubai. United Arab Emirates, 12–14 May 2009. *FAO Fisheries and Aquaculture Report*. No. 915. Cairo, FAO. 2009. 70p. [Bilingual version English/Arabic].

FAO. Report of the third meeting of the RECOFI Working Group on Fisheries Management. Doha, Qatar, 20–22 October 2009. *FAO Fisheries and Aquaculture Report*. No. 922. Cairo, FAO. 2009. 63p.

Swan, J. Review of fisheries laws of certain Members of the Regional Commission for Fisheries. *FAO Fisheries and Aquaculture Circular*. No. 1049. Rome, FAO. 2009. 81p.

Swan, J. Review of fisheries laws of certain Members of the Regional Commission for Fisheries. *FAO Fisheries and Aquaculture Circular*. No. 1049. Rome, FAO. 2009. [Arabic version]. In press.

FAO. Report of the FAO/RECOFI Workshop on Fishery Stock Indicators and Stock Status. Tehran, the Islamic Republic of Iran, 26–29 July 2009. *FAO Fisheries and Aquaculture Report*. No. XXX. Cairo, FAO. 2010. XXp. In preparation.

FAO. Report of the fourth meeting of the RECOFI Working Group on Fisheries Management. Muscat, Oman, 3–5 October 2010. *FAO Fisheries and Aquaculture Report*. No. XXX. Cairo, FAO. 2010. XXp. In preparation.

FAO/Regional Commission for Fisheries. Report of the Regional Technical Workshop on Spatial Planning for Marine Fisheries and Aquaculture. Doha, the State of Qatar, 24–28 October 2010. *FAO Fisheries and Aquaculture Report*. No. XXX. Rome, FAO. 2011. XXp. In preparation.

FAO/Regional Commission for Fisheries. Report of the fifth meeting of the Working Group on Aquaculture. Doha, the State of Qatar, 27 October 2010. *FAO Fisheries and Aquaculture Report*. No. 954. Rome, FAO. 2010. 70p. In press.

**All RECOFI publications are available at:** <http://www.fao.org/fishery/rfb/recofi/en>

The fifth meeting of the Working Group on Aquaculture (WGA) of the Regional Commission for Fisheries (RECOFI) was held in Doha, the State of Qatar, on 27 October 2010 and was attended by the representatives from seven Member countries. The WGA reviewed the outcome and recommendations of the Special Meeting on RECOFI Consolidation and Development held in Rome in May 2010. The WGA discussed national and regional follow-up actions to the two WGA technical workshops on aquatic animal health (Jeddah, Saudi Arabia, 6–10 April 2008) and on sustainable marine cage aquaculture development (Muscat, Oman, 25–27 January 2009). In general it was agreed that the Members benefitted from such technical workshops. It was nevertheless noted that an efficient mechanism on how to best ensure a coordinated and region-wide response and follow-up to key technical recommendations was needed. A brief presentation on the joint RECOFI WGA and Working Group on Fisheries Management (WGFM) Regional Technical Workshop on Spatial Planning for Marine Capture Fisheries and Aquaculture, held in Doha, Qatar, from 24 to 28 October, was presented highlighting the key recommendations and suggested follow-up outputs. The meeting discussed the Regional Aquaculture Information System (RAIS) following the presentation of the first Web analysis report which indicated a steady interest in the information system particularly among the Arabic speaking countries. Actions to further consolidate the system were discussed along with the need to improve the overall communication outputs at the national and regional levels. The WGA finalized its proposed programme of work for the next intersessional period based also on the recommendations from its previous technical workshops. The WGA recognized that the Commission, based on its current level of financial contribution, may not have the required budget to implement a comprehensive aquaculture programme and recommended that some activities could be implemented with extrabudgetary funds. The WGA Focal Point of Qatar was nominated as the new WGA Chairperson.

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