FAN

April 2010 - No. 44

FAO Aquaculture Newsletter

FAO AQUACULTURE NEWSLETTER FAO AQUA
FAO AQUACULTURE NEWSLET

INVITED EDITORIAL

AQUACULTURE GOVERNANCE: WHY DOES IT MATTER?

The FAO Code of Conduct for Responsible Fisheries (CCRF) consists of five introductory articles, followed by an article on general principles and six thematic articles, one of which is Aquaculture Development. The CCRF provides guidelines that satisfy many of the criteria for good governance in aquaculture. But, why does governance matters? Governance matters because of its importance. Empirical research has demonstrated that most of the differences in per capita income between countries can be attributed to governance factors - the collection of laws, institutions, and government policies that make up the economic environment. Those jurisdictions that have "good governance" provide an enabling environment for the accumulation of capital, both human and physical, which in turn enhances their rate of economic growth compared with those jurisdictions with weak governance. Hence, living standards increasingly diverge. These findings confirm Adam Smith's hypothesis, centuries ago, that "a nation's economic growth is largely determined by the policies that governments follow".

Aquaculture is a form of agriculture with similar private property rights. So, its productivity and long-term growth is probably equally dependent on governance. Unless property rights are secure and enforceable, commercial aquaculture will not develop; without them there would be no incentive to invest time and resources, and poaching would be a rational strategy. Similarly, without respect for the rule of law and enforcement of contracts, farmers would have difficulty marketing products and obtaining inputs from suppliers. Even the dissemination of new research and technology, and hence long-run factor productivity, depends on administrative and institutional frameworks. Aquaculture governance should therefore aim to replicate a "virtuous cycle" in which an effective administrative and regulatory framework not only encourages investment, but also increases the efficiency of public services. This should induce investment in backward and forward linked activities. At the farm level, secure property rights and long leases encourage adoption of best practices, and self-regulating management codes.

Indeed, since the creation of the Code, there has been growing realization of the need to address socio-economic and institutional issues. Administrative and legal frameworks can provide the incentives, and the disincentives, for farming to develop responsibly. Regulations and economic measures can eliminate practices that are ecologically and socially harmful without destroying entrepreneurial motivation. This balance between protecting societal well-being, while encouraging wealth creation through the private sector, is the essence of effective governance. In other words, aquaculture governance enhances sustainability. Sustainability is the principal goal of aquaculture governance because it enables aquaculture to prosper over a long time period. Sustainability incorporates the usual four aspects; technical feasibility, economic viability, environmental integrity and social licence.

There is now a consensus that modern aquaculture depends on the private sector and the profit motive. Such aquaculture need not be large scale but does entail a business orientation as with any small and medium enterprise. One of the reasons, and perhaps the largest reason, why entrepreneurs flourish in some jurisdictions but not others is governance. In the absence of effective governance there will be misallocation, influence peddling or stagnation. Governance affects all business, whether aquaculture or any other.

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Cover photos:
Cage culture of tilapia in lake Taal, Philippines,
Courtesy of Melba Reantaso, FAO

CONTENTS

Articles

4 Visibility and Access through the Aquatic Commons

7 Update on the Central Asia an Caucasus Fisheries and Aquaculture Commission

8 Advances in Spatial Analyses, Remote Sensing and Virtual Technologies to Enhance Aquaculture Management

12 Inland Fisheries and Aquaculture

15 The Twelfth Session of the Sub-Committee on Fish Trade of the Committee on Fisheries (COFIFT)

17 Call for contributions to FAO overview of COPs/BMPs in aquaculture

Workshops

21 Environmental Impact Assessment and Monitoring in Aquaculture

22 Regional Workshop on Methods for Aquaculture Policy Analysis, Development and Implementation in Selected Southeast Asian Countries

23 Workshops in Latin America: User-friendly Aquaculture Investment and Management Tool for Small- and Medium-scale Farmers

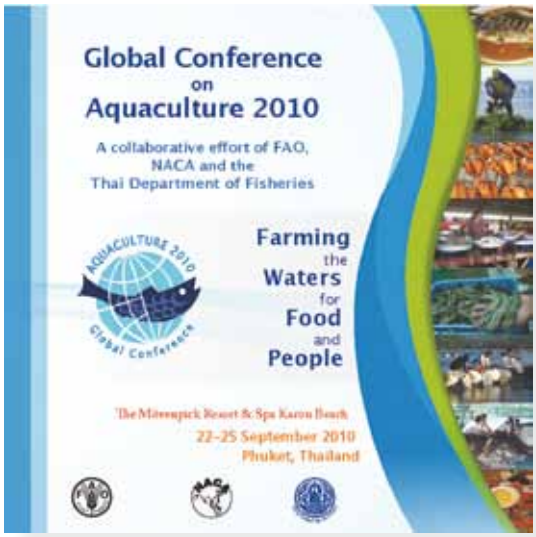
Projects

18 TCP/NAU/3201Milkfish Farming and Environmental Impact Assessment in Nauru

20 GCP/RER/031/TUR: Central Asia Regional Programme for Fisheries and Aquaculture Developments (Under FAO – Turkey Partnership Programme)

Publications

24 New Aquaculture and Aquaculture-related Publications



SPECIAL NOTICE

The Global Conference on Aquaculture 2010

has been rescheduled as follows:

22-25 September 2010

The Mövenpick Resort & Spa Karon Beach

Phuket, Thailand

www.aqua-conference2010.org

Visibility and Access through the Aquatic Commons

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The Aquatic Commons is a thematic digital repository (see http://aquacomm.fcla.edu/) covering the natural marine, estuarine/brackish and freshwater environments. It includes all aspects of the science, technology, management and conservation of these environments, their organisms and resources, and the economic, sociological and legal aspects. This thematic digital repository is sponsored by the International Association of Aquatic and Marine Science Libraries and Information Centers (IAMSLIC) and FAO has supported the development from its conception.

Launched in 2008, the Aquatic Commons repository aims to improve and facilitate the sharing of information on fisheries and aquaculture management. It will ensure the equal participation and coverage of literature from both developing and developed countries, and will provide free and open access of information for all. The preservation of this information and its availability for future generations will be guaranteed. Managers and resource users will be empowered to publish their findings.

In this biennium (2010-2011), FAO is extending its efforts in making grey literature available through the Aquatic Commons. The term "grey literature" refers to documents not controlled by commercial publishers, but published by institutions of which publishing is not the primary business activity. This literature is often difficult to identify and locate and is seldom available through commercial channels. As pointed out in the FAO Technical Guidelines for Responsible Fisheries No. 12 (2009), grey literature is invaluable to science. The published output of research by institutes in developing countries is generally the most relevant if not the only source for local and regional information on fisheries and aquaculture.

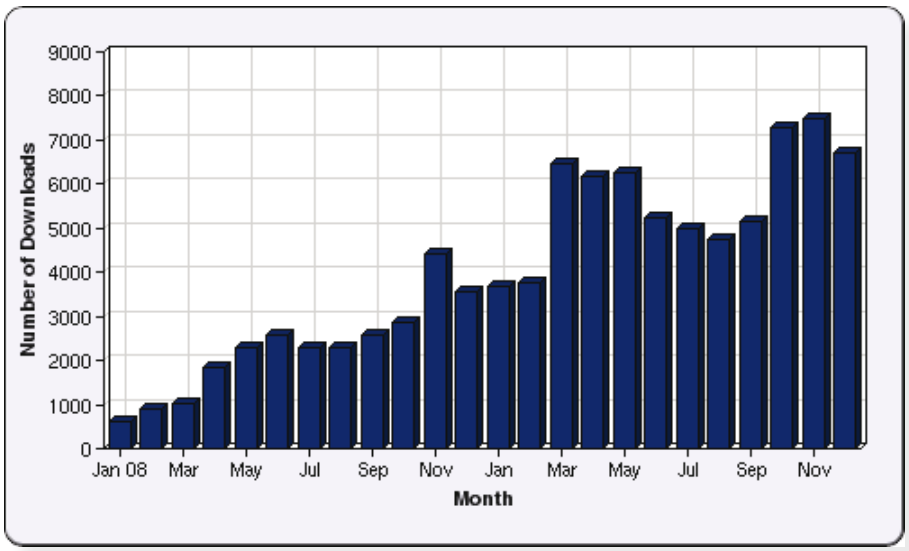
The potential of this repository is enormous and the benefits are already obvious to both depositors and users. For example, small case studies were undertaken in 2008 in collaboration with fisheries institutions in Nigeria, Malawi and Uganda. Looking at this initial work, it is interesting to see that the following article is one of the top ten downloads from the Aquatic Commons:

> Ezenwa, B. and Anyanwu, P.E. (2004). Water recirculatory system technology as a major tool for increased fish production by private fish farmers. In: 18th Annual Conference of the Fisheries Society of Nigeria (FISON), 8-12 December, 2003, Owerri, Nigeria. (http://aquacomm.fcla.edu/852/).

This article was downloaded 1112 times, of which more than 400 times from Nigeria, the country of origin. Also significantly, Nigeria is one of the top users of the Aquatic Commons repository. The uploading of the FISON Annual Conference Proceedings was clearly responding to an information need. This is a good example of how the Aquatic Commons has not only made this information more visible, but has given researchers access to this literature.

The total number of downloads of the repository is now up to 113,000. The graph on page 5 shows the number of downloads from January 2008 to December 2009:

It is interesting to see that of the most frequently downloaded articles, half are related to aquaculture, including several articles from Aquaculture Asia, the quarterly magazine published by the Network of Aquaculture Centres in Asia-Pacific (NACA). Other examples of issuing bodies and contributors in the field of aquaculture are The WorldFish Center, the Institute of Aquaculture of the University of Stirling (UK) and the project Support to Regional Aquatic Resources Management (STREAM).



Source: http://irstats.aquacomm.fcla.edu/irstats-aquacomm

FAO's support to the Aquatic Commons aims at assisting institutions in developing countries regarding the improvement of access, and the sharing and preservation of fisheries and aquaculture management publications. The publications from developing countries will be integrated into the mainstream of digital information. In this way, the capacity of these institutions to produce and share digital publications will be enhanced.

Building on the experience of case studies undertaken in 2008, FAO's Fisheries and Aquaculture Library (FBL) has started a project for the Aquatic Commons repository, in collaboration with the Aquatic Sciences and Fisheries Abstracts Bibliographic Database (ASFA) and financed by the ASFA Trust Fund.

FBL has a long history of involvement with information from developing countries. Since its establishment in 1967, FBL was aware of the lack of visibility of this information. Consequently, exchange agreements were set up with institutions in developing countries, thus making their publications available and visible to FAO staff and visiting experts. Over the years, the multidisciplinary nature of the information needed for fisheries management has been supported by the sizable collection of the David Lubin Memorial Library, FAO's main library. The grey literature collected by FBL was also made known to the world through inclusion in ASFA.

ASFA, for which FAO provides the Secretariat, is an international network of participating ASFA Partners (institutions or libraries dealing with aquatic sciences) which cooperates in capturing and disseminating the world's aquatic science literature. (See the FAO ASFA Web site for further details http://www.fao.org/fishery/asfa/en).

The ASFA Partnership (66 members as of April 2010) covers all 5 continents of the world. Each partner focuses on the monitoring of journals and other literature specific to their country or geographic area and contributes to the ASFA Database by producing bibliographic references to these publications. This literature includes not only periodical titles and books, but also grey literature material such as documents and research reports produced by the institute itself, many of which are not available elsewhere. By participating in the ASFA network, an ASFA Partner increases the visibility of its scientists and research initiatives.

When founded in 1971, ASFA was produced as a printed journal, with a view to developing a system which would produce the abstracting publication as well as providing a computer-based information retrieval system in aquatic sciences. Computer-based products first appeared in 1980, when ASFA was available for users to purchase on magnetic tape. In 1985, ASFA was offered on CD-ROM and since 1995, ASFA is searchable through CSA's Internet Database Service (CSA Illumina).

Almost 25 percent of the ASFA database consists of grey literature, and document availability is fundamental for this type of literature. Every effort is made to include full text links in the records on the ASFA database.

The Aquatic Commons project involves the digitization of grey literature from institutions in developing countries which is available in the FBL. It will guarantee that the publications are repatriated to the originating institution in digital format (PDF files). The inclusion of metadata and electronic copies of the literature in the Aquatic Commons repository is non exclusive and the copyright remains with the publishing institution. In the ASFA bibliographic database, links to these full text online versions will be added to existing records, or new records including links to the items in the repository will be created by the FAO ASFA Group, or the appropriate ASFA partner.

Illustration by Emanuela D'Antoni from the FAO Technical Guidelines for Responsible Fisheries 12

This grey literature will gain the benefits of visibility in a digital repository, and its metadata will be publicly harvested, e.g. findable using Google or Avano (a harvester in the field of marine and aquatic sciences, see http://www.ifremer.fr/avano/). The PDF files will be of high-quality, compressed and optimized for web viewing and also, because of their size, easily searchable and downloadable. For the participating institutions there is no need for local information technology and preservation will be ensured.

Institutions interested in joining our efforts in building up the Aquatic Commons repository are invited to contact the FAO FBL via e-mail through the authors of this article.

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Update on the Central Asia and Caucasus Fisheries and Aquaculture Commission

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FAO's governing Council unanimously approved on the creation of a new regional fisheries and aquaculture management body for the Central Asia and Caucasus region. The approval of the Agreement on the Central Asian and Caucasus Fisheries and Aquaculture Commission took place at the Hundred and Thirty Seventh Session of the Council on 1 October 2009 through Resolution No 1/137.

The FAO-affiliated commission (a so called Article XIV body under the FAO Constitution) will become active as soon as three countries formally accept it at the national level. In December 2009, the Director General of FAO sent the Agreement and related information on the instrument of acceptance to the following countries: Armenia, Azerbaijan, People's Republic China, Georgia, Islamic Republic of Iran, Kazakhistan, Kyrgyzstan, Russian Federation, Tajikistan, Turkey, Turkmenistan, Uzbekistan, Afghanistan, Mongolia and Ukraine. In February 2010, the first instruments of acceptance were deposited by the Governments of Tajikistan and Kyrgyzstan. A third national-level ratification is expected to come quickly.

Talks toward the establishment of the new Commission started in Dushanbe, Tajikistan in November 2008. Various meetings followed; these included meetings which took place in Turkey in March 2009 (Ankara[1]), June 2009 (Trabzon[2]) and February 2010 (Istanbul). In these meetings, the type of collaboration was discussed and the Agreement and Rules of Procedure for the Commission were prepared. Many of the above listed countries have participated in the establishment process of the Commission so far, as well as observers from the Scientific Information Center of the Interstate Coordination Water Commission (SIC - ICWC), the World Bank, the Turkish International Cooperation Agency (TICA), the Network of Aquaculture Centers in Eastern Europe (NACEE) and the Caspian Environment Programme.

FAO supported the establishment of the commission through its Technical Cooperation Programme (TCP) facility project "Establishment of a Central Asian and Caucasus Regional Fisheries Organization (TCP/RER/3203)" and through its Central Asia Regional Programme for Fisheries and Aquaculture Development (FishDev – Central Asia) (GCP/RER/031/TUR), funded by the FAO Turkey Partnership Programme (FTPP).

FAO's Sub-regional Office for Central Asia (SEC) in Ankara, Turkey, will secretariat assistance until the Commission becomes fully operational; the establishment process is further guided by the FAO Legal and Ethics Office (LEG), the Policy, Economics and Institutions Service of the FAO Fisheries and Aquaculture Department (FIPI) and FAO SEC.

The Commission is expected to work on both capture fisheries and aquaculture issues. In terms of aquaculture activities of the Commission, issues such as transboundary movement of live fish, fish introductions, restocking, hatchery management and better management practices (BMP) development, are likely to get prominent in the work programme for the first five years of the Commission. The Commission would also support the normative work on above-listed issues as well as assist in collection and review of aquaculture data and information in the region and technology transfer and human capacity development.

The Government of Kyrgyzstan has kindly offered to host the 3rd Intergovernmental meeting on Fisheries and Aquaculture in Central Asia and the Caucasus in the period 6-8 September 2010 on the shores of Lake Issyk-kul. Preparations for this meeting by the FAO Secretariat[3] and the Kyrgyz Government are ongoing. ■

[1]Report of the Steering Committee Meeting to Prepare for the second Regional Intergovernmental Meeting on the Establishment of a Central Asian and Caucasus Regional Fisheries Arrangement. Ankara, Turkey, 24 – 26 March 2009, FAO Fisheries and Aquaculture Report, No. 900, 2009 (Bilingual) accessible at: ftp://ftp.fao.org/docrep/fao/012/i0918b/i0918b00.pdf

[2]Report of the second Intergovernmental Meeting on the Establishment of Central Asian and Caucasus Regional Fisheries Organization. Trabzon, Turkey, 3–5 June 2009. FAO Fisheries and Aquaculture Report, No. 912, 2009 (Bilingual) accessible at: http://www.fao.org/docrep/012/i1374b/i1374b00.pdf

[3]More information can be obtained from the FAO Secretariat to the Steering Committee which supports the establishment process, Mr Raymon Van Anrooy, SEC Fishery and Aquaculture Officer, e-mail: Raymon.vanAnrooy@fao.org

Advances in Spatial Analyses, Remote Sensing and Virtual Technologies to Enhance Aquaculture Management

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Attention is presently turning to the processes, methods, and tools that allow the principles of the ecosystem approach to aquaculture (EAA) (Soto, Aguilar-Manjarrez, and Hishamunda (2008) to be translated into practical implementation.

According to a recent review by Ferreira *et al.* (in preparation), virtual technology is a way by which conceptual models can be made more formal and tested against reality. It involves the collection of data, the integration of these data within a system (information system), the formalization of the system and the action on the system (simulation) with a given purpose. Virtual technologies have an important role to play, be it through the use of (i) geographic information systems (GIS), remote sensing and ecosystem-scale models to determine suitability and carrying capacity; (ii) farm-scale tools to support licensing, environmental impact assessment, and optimisation of production; or (iii) sensors for data acquisition for monitoring and modelling.

The present article includes a few extracts from the above review on "Progressing aquaculture through virtual technology and decision-making tools for novel management". However, in this article, emphasis is placed on the use of spatial planning tools including GIS, and remote sensing for data management, analysis, modelling and decision-making to illustrate the work being carried out by the Aquaculture Service (FIRA) of the FAO Fisheries and Aquaculture Department.

Natural resource managers, aquaculturists, and other stakeholders, pose questions on water quality diagnosis, growth and system carrying capacity and environmental effects, local-scale interactions, prediction of harmful algal blooms, disease control systems, environmental product certification, socio-economic optimization, spatial definition of natural and human components of ecosystems and of competing, conflicting and complementary uses of land and water. A good many of these can be addressed, at least in part, by means of virtual technologies and decision-support tools. Different stakeholders are seeking answers to these questions at differing time and space scales. For instance, an environmental manager for an estuary or coastal bay might be interested in system-scale carrying capacity, both in terms of production and environmental impact, while at the level of Integrated Coastal Zone Management (ICZM) the role of bottom-up (e.g. nutrient-related) effects and top-down (e.g. shellfish grazing) control might be an important consideration. Farmers will also be concerned with optimizing production and profit, disease control, and market acceptance. While, farmers and managers in the west may be more focused on open coastal systems, in Asia, Central and South America, or in Africa, their emphasis may be more on inland or fringing systems such as shrimp and/or fish pond culture.

The data that are needed for management and decision-making are similar across most aquaculture operations. However, since space and time resolution of the datasets are dependent on the scale of the aquaculture operation, data acquisition approaches and needs also expand accordingly.

FAO-FIRA's Global Gateway to GIS, remote sensing and mapping for fisheries and aquaculture (www.fao.org/fishery/gisfish) is a rich resource of information on publications and case studies demonstrating the benefits of these tools to resolve issues in fisheries and aquaculture. Aguilar-Manjarrez, Kapetsky and Soto (2010) provide a description of selected case studies illustrating a range of such virtual tools; previous issues of the FAO Aquaculture Newsletter [e.g. FAN 35 (pp. 13–19), FAN 37 (p.33), FAN 38 (pp. 32–33), FAN 41 (p. 11) and FAN 42 (pp. 24–25; pp. 36-39)] describe activities on GIS, remote sensing and mapping at FIRA.

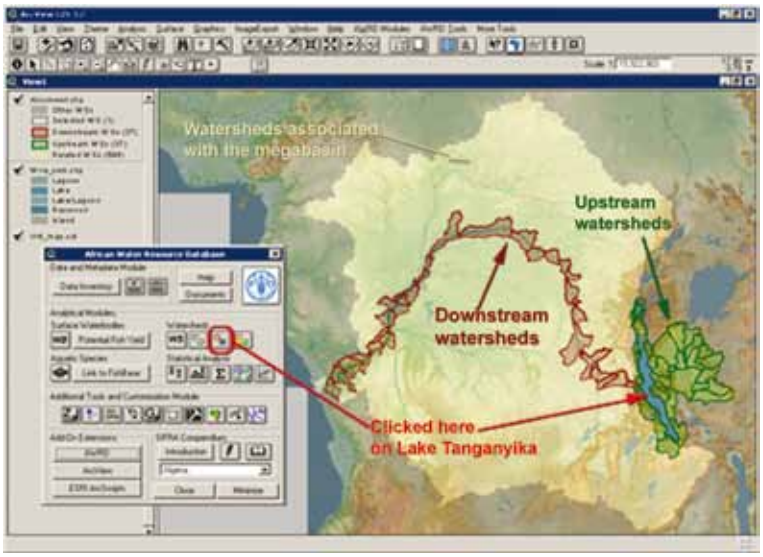
Examples of current applications on virtual technologies at FIRA are illustrated below addressing a range of culture types, environments and cultivated species.

EXAMPLE APPLICATIONS

Example No. 1: African Water Resources Database (Jenness *et al.*, 2007a;b)

The African Water Resource Database (AWRD) contains an assortment of custom-designed applications and GIS-based tools to display and analyze spatial data. AWRD tools can assist in a wide variety of issues such as: improving the reporting on status and trends in inland fisheries and aquaculture; co-management of shared inland fisheries resources; transboundary movements of aquatic species; and increased participation of stakeholders in the decision-making process about watershed area uses. The Watersheds Module and related analytical tools represent perhaps the most comprehensive and intensive programming effort undertaken within the AWRD interface. This module is specifically designed to analyse and visualize watersheds which can be of great value for assessing pollution from runoff of "upstream" watersheds into aquaculture ponds or residuals from aquaculture ponds into "downstream" watersheds. Analysis of invasive and introduced aquatic species is another area where this tool has great value because such introductions can have impacts both upstream and downstream within a hydrological system. Figure 1 shows upstream and downstream watersheds for Lake Tanganyika. At present, two FAO Technical Cooperation projects in Cameroon and Mauritania have made use of the AWRD to support the development of master plans for the development of aquaculture in Cameroon, and aquaculture and inland fisheries in Mauritania. The AWRD also serves as an excellent tool for GIS training.

Figure 1
Visualization of the flow regime associated with lake Tanganyika



Source: Jenness *et al.* (2007a;b)

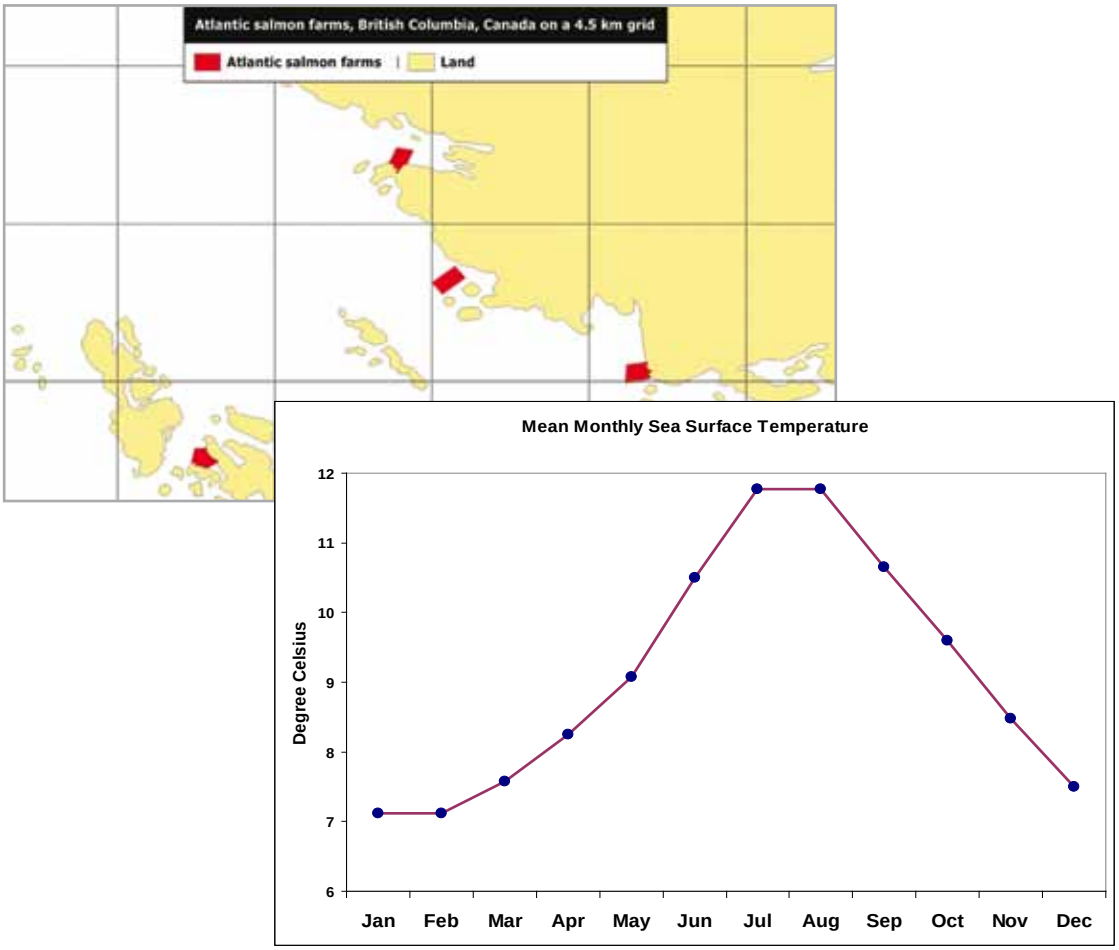
Example No. 2: GIS and remote sensing for the development and management of offshore aquaculture (Kapetsky *et al.*, in preparation; Dean and Salim, in preparation)

The issues associated with the expansion of mariculture to offshore areas can be categorized as technical, environmental, social, economic and legal. Environmental issues relate both to suitability of mariculture operations and more broadly to mariculture as a user of ecosystem services. Many of these main issues have components that can be addressed separately or together using spatial analyses, particularly the technical, environmental and jurisdictional problems. Among the criteria that have to be satisfied for offshore mariculture are appropriate locations for good growth and high survival rates of cultured species. In line with this criteria, FIRA is currently exploring the use of fish growth models as one of the means to estimate aquaculture potential for offshore aquaculture. Our vision is for a model that could be run for all geographic areas of interest to identify locations with growth advantages for any species. Because of the ready availability of a growth model and because of the relatively easy access to farm locations and temperature data through remote sensing climatologies, the Atlantic salmon model is being used to test the concept. Locations of Atlantic salmon farms in four countries, Canada (British Columbia – see Figure 2), Chile (limited area), Ireland and Norway, were selected to span the broadest range of latitudes available. Also, as our focus is on offshore mariculture, farms with the most exposure to the open sea were selected in Norway and Ireland. At these selected farm locations, mean monthly temperatures were obtained from remote sensing climatologies and used as input to the growth model. The output was the number of days required to reach a harvestable size at each farm location. The preliminary results showed a near five-month difference between Chile and Norway for the time required to reach a harvestable size. The results suggest that real differences between growth potentials among locations can be detected through remote sensing. The next step is to validate the results with actual growth data from the farm locations and eventually to model growth for species relevant to mariculture in developing countries.

Example No. 3: National Aquaculture Sectors Overview (NASO) map collection (in preparation)[1]

FIRA is in the process of mapping aquaculture sites (see Figure 3 as an example) as part of the National Aquaculture Sectors Overviews (www.fao.org/fishery/naso/search/en). The NASO map collection is to be released via the world wide web in June 2010. The collection consists of Google maps showing the location of aquaculture sites and their characteristics at an administrative level (state, province, district, etc) and in some cases even at an individual farm level depending on the degree of aquaculture development,

Figure 2
Estimating potential growth: acquiring data from Atlantic salmon farm locations in Canada



the resources available to complete the data collection, and the level of clearance provided by country experts (Figure 3). Data collection is of fundamental importance to the implementation of the Ecosystem Approach to Aquaculture, the improvement of aquaculture statistics and the dissemination of information. The work is still in its early stage but holds potential use in a number of ways such as the development of an aquaculture investment and management tool currently under construction (N. Hishamunda, and D. Valderrama, FAO-FIRA, pers. comm.., 2010; see also page 23, this issue); monitoring status and trends of aquaculture development and addressing site selection issues.

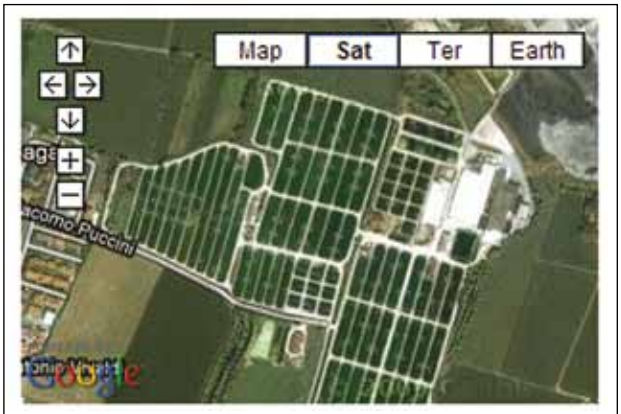
CONCLUSIONS

The aquaculture industry is going to be affected by many different issues and trends over the coming years, often operating concurrently, sometimes in unexpected ways, and producing changes in the industry that may be very rapid indeed. Without a doubt, virtual technology and decision-support tools will play important roles in addressing many of these, and will therefore underpin many elements of the Bangkok Declaration and Strategy. Some of the directions and challenges are: innovations that will drive virtual technology; information exchange and networking; links between industry and research centres; collaboration between developed and developing countries; strategic alliances in developing countries; making virtual technology tools more production- and management-oriented. Even if attractive and promising, these tools will have to be adapted to local realities and conditions to really become useful (and used) in the future. These require a compromise with respect to ease of use, data requirements, and scientific complexity.

In the future, virtual technologies will play an increasingly important role in the prediction of potential aquaculture siting and production, environmental impacts, and sustainability. The next decade will bring about major breakthroughs in key areas such as disease-related modelling, and witness a much broader use of virtual technology for improving and promoting sustainable aquaculture in many parts of the world.

More specific to GIS, there are many benefits that GIS can bring to aquaculture management processes, from simple mapping to sophisticated modelling. Aguilar-Manjarrez, Kapetsky and Soto (2010) demonstrated that GIS has the potential to support EAA, therefore,

Figure 3
NASO map collection for Italy



Freshwater farm, sturgeons and stripped bass, North Italy

the principal task is to determine best ways to utilise these spatial tools for implementing EAA. An enabling environment is crucial and it is essential to match potential requirements and current capacities (human resources, infrastructure, finances) at national and/or regional level so that capacity building activities can be initiated.

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Inland Fisheries and Aquaculture[1]

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At the forthcoming Global Conference on Aquaculture 2010, several of the expert panels are dealing with the many interactions of inland fisheries and aquaculture. Increased exposure of issues related to inland fisheries will benefit the sector as the role that inland fisheries play in livelihoods of people in many parts of the word is under-appreciated and under-valued. In many parts of the world, inland fisheries provide high quality protein, essential nutrients and minerals that are often difficult to obtain from other sources of food; inland fisheries provide economic opportunity and a "safety net" that allows for continued food production when other sectors may fail. In developed and some developing countries, inland fisheries have become utilized for recreation rather than for food production.

Inland fisheries are extremely diverse and harvest a tremendous amount of biodiversity. Freshwater ecosystems represent about 2-3 percent of the marine area – yet contain ~40 percent of known fish species. Some of this biodiversity is threatened or rare and inland fish species have been identified as the most threatened group of vertebrates used by humans. Aquaculture can be a component of species' recovery programme if integrated into a broader management framework; aquaculture could also exacerbate problems with endangered species by inappropriate use of resources, introduction of alien invasive species, or by facilitating the spread of pathogens.

Contribution of inland fisheries

Readers of FAN will know that aquaculture is the fastest growing food production sector. With over 40 percent of "fish" consumption coming from aquaculture globally (and this percentage is expected to increase), aquaculture is seen as viable means to provide quality protein to a growing human population. However, less well-known is the contribution that inland fisheries makes to fish production. This is because of (a) the varied and diffuse nature of many inland fisheries operating in remote areas, (b) a lack of awareness and policies on inland fisheries in national agendas, (c) poorly defined market chains or infrastructure dealing with catch from inland waters, (d) the fact that much production is consumed or traded locally and does not enter formal economy, and (e) the high cost of collecting dispersed information. Although countries report ~10.2 million tonnes produced by inland capture fisheries, this is surely an underestimate.

Since FAO started collecting fisheries statistics in 1950, inland fisheries has contributed between 5 and 10 percent to annual fish production globally. Inland fisheries, thus, appear to contribute a relatively small proportion of the world's total fish production compared to marine fisheries and aquaculture (Figure 1 page 14). However, hidden behind the aggregated figures, there are many countries where inland fisheries are very important. Figure 2 (page 14) shows the percentage contribution of inland fisheries, marine fisheries and aquaculture in six developing countries that are all major fish producers, and which all have access to abundant water resources.

Inland fisheries provide food and employment in rural areas where few other options are available. The Big Numbers Project (BNP)[2] reported that over 60 million people in developing countries are involved in aspects of small-scale inland fisheries. A large share of the marine catches are reduced to fishmeal and oil used to raise farmed fish. Tacon and Metian (2009) showed that 23.8 million tonnes or 29 percent of total marine capture fisheries landings in 2006 were used as feed. Regarding contribution to rural nutrition, a large part of aquaculture and marine production may be sold on major markets and even exported while inland fisheries generally produce low value product that are consumed in the fishing households or are sold locally. Thailand is a good example. It is a nation with a very high consumption of fish with an average consumption of 31 kg/person/year almost double the global average of 16 kg/person/year (Lymer *et al.*, 2008b). It is also a major exporter of fish products. Lymer *et al.* (2008b) found that Thailand produced a total of 3.91 million tonnes from capture fisheries in 2004, the same year aquaculture production was 1.26 million tonnes (FAO FishStat+, 2010).

If the amounts of fish that is converted to fishmeal and oil, and the share of the fish which is exported is deducted from the totals, inland fisheries provides 36 percent of the fish consumed domestically in Thailand; Lymer *et al.* (2008b) believe that this is probably still an underestimate of the contribution by inland fisheries.

Artisanal inland fisheries can also provide income as well as food. In rural markets, fish can readily be converted into cash or bartered and, importantly, the cash can be obtained for as long as the fishing season lasts, at times all year round. In the Zambezi floodplain for instance,

data suggest that the contribution of inland fisheries to household cash income is higher than cattle-rearing and sometimes crop production (Turpie *et al.*, 1999) (Table 2).

Inland fisheries and aquaculture

There are strong links between inland fisheries and aquaculture and the interaction of these sectors is being actively addressed by FAO. The use of inland fishery resources in capture-based aquaculture and the use of hatcheries in support of culture-based fisheries are two technical areas of interaction. Capture fisheries for Chinese carps in many reservoirs and small lakes in Asia is supported by hatchery production of these species; similar examples exist in Mexico. Initial production of Pangasius catfish in S.E. Asia relied heavily on wild caught juveniles. Although the use of wild seed has largely been replaced by hatchery-produced seed, issues arise concerning (1) capture of wild seed may have impacts at sub-species levels and (2) management measures should be seen within an ecosystem framework, where protection of critical habitats, such as spawning areas, needs to be included as a management priority along with the sustainable capture of seeds. Rice paddies contain a tremendous amount of aquatic animal diversity that is used as food and medicine to rural areas. Recommendations to enhance this production involve self-recruiting species and aquaculture, as well as water and land management.

C. PONGSRI, FAO

Inland fisheries in Myanmar leasable fishing "Inn"

FAO is creating guidelines for the eco-labelling of fisheries and fish products from inland capture fisheries that follow closely those developed and approved from marine capture fisheries. However, a significant difference between marine and inland capture fisheries that will need to be addressed in the guideline is the important role that aquaculture plays in some inland fisheries. How eco-labelling can be obtained for a fishery that relies on a farmed product will be a key consideration.

Table 1. Total fish production in Thailand from marine fisheries, inland fisheries and aquaculture, and the use of the products. a: data from FAO FishStat+, b: calculated from Thai fisheries export (FishStat+) – Marine export (Lymer *et al.* , 2008b), all other data from Lymer *et al.* (2008a) and calculation based on these data.

	Production (tonnes)				Contribution (%)		
	Marine	Inland	Aquaculture	Total	Marine	Inland	Aquaculture
Production	2850545	1060320	1259983[a]	5170848	55	21	24
Fishmeal	771723	0	0	771723	100	0	0
Export	796344	0	640131[b]	1436475	55	0	45
Discards	26360	0	0	26359.69	100	0	0
Food	1282478	1060320	619852	2962650	43	36	21

Table 2. Contribution of fishery to households' cash income (US$/household/year) in different parts of the Zambezi basin, compared to other activities [percentage of total household income]

	Barotse flood-plain	Caprivi-Chobe wetlands	Lower Shire wetlands	Zambezi Delta
Cattle	120	422	31	0
Crops	91	219	298	121
Fish	180	324	56	100
	43%	28%	13%	39%
Wild animals	6	49	1	0.4
Wild plants	24	121	48	29
Wild foods	0	11	7	4
Clay	2	0	8	0.1

Source: Turpie *et al.* (1999)

Moving forward

The Foresight Study[4] examined drivers that influence inland fisheries in order to "clarify some of the issues regarding the status of inland fishery in order to define their role in food security. It also addresses the information needed for the formulation of management policies, assesses the human impacts of changing resource availability and determines the impacts of other uses of water and landscape impacting on the fisheries". An objective of an ecosystem approache is to understand these drivers and include information necessary for wise decision making that considers relevant stakeholders as well as the fishery resources. Thus, it is in the mutual interest of both the aquaculture and fishery sectors to understand one another. Aquaculture may provide an alternative to inland capture fisheries in some areas, but may be economically unviable in other areas when inland fisheries are more cost-effective. Certainly, the use of inland fishery resources for aquaculture should not adversely impact local communities that rely on those resources for their livelihood. It is with this objective in mind that FAN will include inland fishery topics in its upcoming issues; FAN looks forward to these future contributions.

[1]FAN will regularly feature relevant articles on aquaculture-related inland fisheries articles as an important sector of aquaculture and to support efforts to promote and implement ecosystem approaches to fisheries (EAF) and aquaculture (EAA).

[2]Rescaling the contribution of capture fisheries, An overview with focus on developing country case studies. A report of the Big Numbers Project, FAO and World Fish Center Sponsored by PROFISH – World Bank

[3]FAO unpublished material, "*Use of wild fish/fishery resources for aquaculture production*" output of the project "*Towards sustainable aquaculture: selected issues and guidelines*" implemented by FAO and funded by the Government of Japan.

[4]Foresight Programme. Food and Farming Futures Project of the UK – draft 2009.

Figure 1. Inland fisheries contribution to the world's total fish production compared to marine fisheries and aquaculture (Source: FishStat+ 2010)

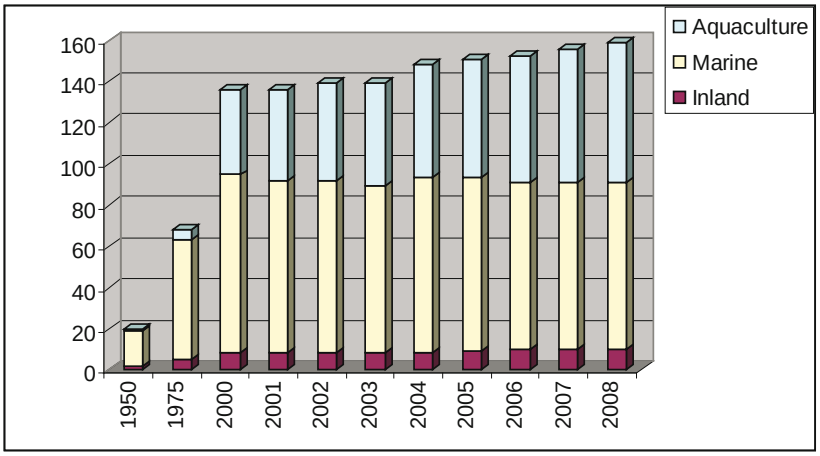
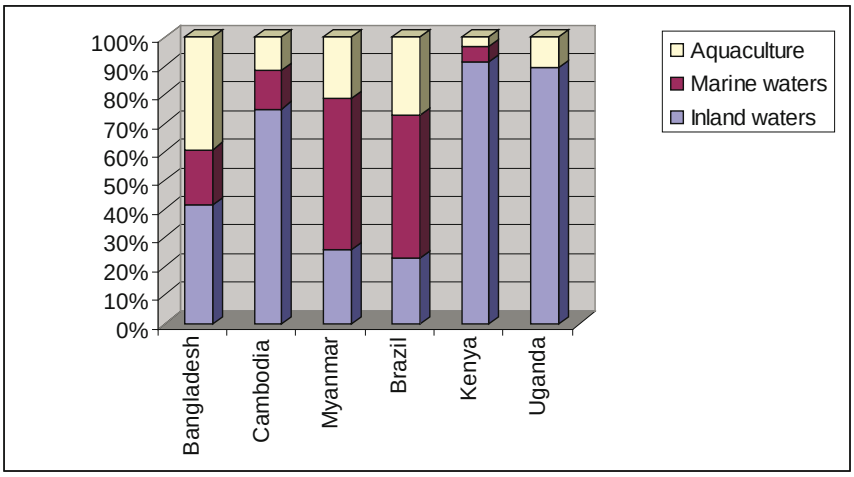


Figure 2. Percentage contribution of inland fisheries, marine fisheries and aquaculture in six developing countries that are all major fish producers, and which all have access to abundant water resources. (Source: FishStat+ 2010)



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The Twelfth Session of the Sub-Committee on Fish Trade of the Committee on Fisheries (COFI:FT)

Buenos Aires, Argentina, 26 to 30 April 2010

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This was the first time that this Sub-Committee convened outside Europe. The Session was attended by 38 Members of FAO and by Observers from nine intergovernmental and non-governmental organizations.

During a special visit, the President of Argentina, Her Excellency Cristina Fernández de Kirchner addressed the meeting. The welcoming address was delivered by Mr Norbert Yauhar, Under-Secretary for Fisheries and Aquaculture, Ministry for Agriculture, Livestock and Fisheries.

During the meeting, the Sub-committee discussed a number of issues of relevance to international trade in fish and fisheries products. Among these were the following:

Trade-Related Activities in FAO

The Sub-Committee appreciated the broad range of trade-related activities carried out by the Fisheries and Aquaculture Department. In particular, delegates congratulated FAO for its role in obtaining improved fisheries classifications in the World Customs Organization, highlighting the need for accurate and detailed trade statistics for a wide range of purposes, including that of fisheries management.

The Sub-Committee underlined the importance of FAO's work in capacity-building for developing countries, in particular in relation to market access and value-addition for small-scale producers in developing countries.

Delegates noted the growing role of certification and related traceability schemes and the potential additional burden and cost this could place on developing country producers, especially the small-scale sector. Members encouraged further integration and cooperation between the Secretariats of the Sub-Committees on Fish Trade and on Aquaculture, highlighting the need for a greater focus on the role of aquaculture in international markets and trade.

Recent Developments in Fish Trade

Delegates highlighted the dynamic, mobile and global nature of the fisheries sector and the increased relevance of non-governmental stakeholders in the value-chain, especially at the post-harvest level. Members highlighted the importance of fish consumption and its many nutritional and health related benefits referring to a number of national policies and initiatives in this respect.

A.LEM, FAO

President of Argentina, Ms Cristina Fernández de Kirchner, addressing the Session

Members underlined the growing role of aquaculture in production, trade and consumption and the need to adequately reflect this in future work. The Sub-committee also underlined the importance of the ongoing negotiations on fisheries subsidies in the WTO.

Review of Market Access Requirements

The Sub-Committee expressed its support to the work of FAO in support of the Codex Alimentarius standard setting activities for fish and seafood safety, quality and traceability and for the technical advice, training and capacity building in developing countries to enable these countries to meet international market requirements by implementing good practices in fisheries and aquaculture to ensure the safety and quality of

fish products. The Sub-Committee reiterated the importance of Codex Alimentarius work to promote harmonization and the use of the best available scientific information for standard setting and certification.

Best Practice Guidelines for Integrated Traceability

The Sub-Committee agreed that traceability initiatives were useful tools to verify the integrity of the supply chain and noted that in the fisheries sector they are mainly used to help meet both food safety and sustainability objectives. Members agreed on the benefits of integrating traceability requirements but also recognized that the traceability requirements for food safety were somewhat different from those linked to sustainability.

Fish Trade and Food Security

The Sub-Committee underlined the importance of enhancing food security and the role of the fisheries and aquaculture sector in contributing towards that goal through fish consumption, employment and trade. It was noted that national, regional and global food security policies and funding frameworks often fail to include or integrate adequately the fisheries and aquaculture sector in the overall policy framework. Members welcomed the inclusion of food security in the G8 and G20 agendas, highlighting the need to address fisheries and aquaculture concerns under these programmes.

The Sub-committee noted the crucial role of aquaculture in future food security and the need to implement policies that promote sustainable aquaculture development on a global basis, including in regions where aquaculture production is today limited. Some Members further highlighted the need to ensure the quality as well as the integrity of aquaculture input factors such as seed and feed, and the crucial role of fish disease management.

The Sub-Committee stressed that in order to achieve national food security, institutional capacity building is often necessary, in addition to assistance of a more technical nature. Members welcomed the programmes available from national development agencies, international funding agencies and organizations in contributing towards enhanced food security but stressed the need to integrate sustainability and responsible fisheries and aquaculture in implementing these programmes. ■

Call for contributions to FAO overview of COPs/BMPs in aquaculture

The FAO Aquaculture Service calls for contributions to the development of a worldwide overview and databank of Codes of Practice, Codes of Conduct, Best (Better) Management Practices, Technical Guidelines, etc. in aquaculture.

We would like to invite all those interested in the promotion of sustainable aquaculture development to advise FAO of the existence of COP/BMP documents in their countries or regions. In particular, all aquaculture producer associations and farmer organizations are encouraged to send to FAO their Codes of Practice, Codes of Conduct, Best (Better) Management Practices, Technical Guidelines, etc. COPs/BMPs in aquaculture, as available with national and international organizations, would also be important and should also be contributed. These documents could be sent to FAO in hard copy format or electronic format, or, if available online, by informing FAO of the relevant website, internet link or URL. For further information on the scope of this initiative, please visit FAO's aquaculture gateway page: ftp://ftp.fao.org/FI/DOCUMENT/aquaculture/COPBMP/call.pdf

Your collaboration and contributions to this initiative will be most appreciated, and your participation will be duly recognized and acknowledged.

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Chief
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Food and Agriculture Organization of the United Nations (FAO)

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TCP/NAU/3201
Milkfish Farming and Environmental Impact Assessment (EIA) in Nauru

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The TCP/NAU/3201 project "Milkfish farming and environmental impact assessment in Nauru", with a total budget of USD 39 493.00, was approved in August 2009 to provide technical assistance in re-establishing milkfish farms in Nauru. The project is designed to assist the Nauru Fisheries and Marine Resources Authority (NFMRA) and the Nauru Aquaculture Association (NAQUA) in the following two areas, namely:

- to guide the NFMRA and the NAQUA on the most appropriate path for re-establishing milkfish farms in Nauru and to provide basic training on husbandry and hatchery skills.
- to undertake a study on the potential environmental impact of proposed dredging in the Buada Lagoon, the largest freshwater lake in Nauru, with particular reference to its impact on the capacity of the lagoon to continue to support non-intensive milkfish farming.

Nauru is located at about 48 km south of the equator and described as a single limestone island. Its land area is 21 km². In Nauru, milkfish (*Chanos chanos*) is traditionally the most valued fish species. In the late 1960s, tilapia (*Oreochromis mossambicus*) was introduced into the country for the purpose of feeding on mosquito larvae and as food fish. Despite the original purpose, tilapia became abundant in the lagoons and ponds, and competed with milkfish stock. As a result, milkfish farming in the island slowly diminished. Under the Five Year National Aquaculture Development Plan developed by the NFMRA in 2005, the revival of milkfish farming was given priority to support food security in the country.

Under the TCP project, a TCDC expert on milkfish farming was dispatched from 25 January to 13 February 2010 while a retired expert on environmental impact assessment (EIA) undertook his mission from 8 February to 20 February 2010. A one week overlap of mission of the two experts enabled them to work together.

J. E. BASCO, FAO

Buada Lagoon, Nauru

The TCDC expert provided the NFMRA and the NAQUA with a set of recommendations pertaining to the following:

- Existing milkfish farming system was reviewed in the Buada Lagoon and 21 other lagoons/ponds.
- Preliminary assessment on basic water parameters (depth, silt depth, temperature, salinity, transparency) and other observations were conducted in the Buada Lagoon and 21 other lagoons/ponds.
- Potential sources of milkfish fry were assessed. Appropriate fry collection geara (e.g. skimming net, push net) and fry storage, transport and stocking procedures were introduced. Field demonstration of milkfish fry collection was conducted.
- In the lagoon/pond preparation for milkfish fry stocking, eradication methods of unwanted species (e.g. tilapia) and fertilization methods of lagoons/ponds were demonstrated.
- Calculation of appropriate stocking density of milkfish fingerlings in a lagoon/pond was introduced. The importance of water

management, such as monitoring basic water parameters (temperature, salinity, transparency, dissolved oxygen) was emphasized.

- A one-day stakeholder workshop, with a total of 37 participants attending, on milkfish farming was conducted with lectures and practical sessions on the following subjects:

  - Milkfish farming systems
  - Milkfish deboning
  - Milkfish deboning demonstration
  - Field practical session:

  ✓ Demonstration of pond eradication (tilapia and other unwanted species)
  ✓ Pond preparation and fertilization
  ✓ Basic water sampling procedures

The environmental impact assessment (EIA) exercise for the Buada Lagoon and the Buada community was carried out by the retired expert on EIA aimed to provide significant environmental management input into the implementation of the Buada Lagoon Rehabilitation Project funded by the Global Environmental Facility (GEF) Small Grant Programme, in relation to the revival of milkfish farming in the lagoon. The assignment of the expert concentrated on the following areas.

- review of existing environmental conditions (e.g. geological and topographic conditions, lagoon water conditions, ecological resources, and socio-economic and socio-cultural resources)
- other potential alternatives (other reasonable foreseeable and environmental alternatives)
- assessment of expected environmental impacts and mitigations
- socio-economic assessment
- environmental management plan (e.g. summary of impacts, proposed mitigating measures, monitoring programme and parameters, public consultations, responsibility for mitigation and monitoring requirements)
- consultations with members of the Buada Lagoon Owners Association.

M. IZUMI, FAO

M. IZUMI, FAO

One-day Stakeholder Workshop on Milkfish Farming in Nauru

For further strengthening national capacities (knowledge and skills) in aquaculture in general, it was recommended that the NFMRA regularly conduct local training workshops for the NAQUA members and other stakeholders. Direct assistance to the NAQUA members and individual farmers must be considered through the assistance of bi-lateral or multi-lateral donors under the good coordination of NFMRA. Particularly in milkfish farming, early consideration of training for the NFMRA staff was recommended to be undertaken in countries which have appropriate milkfish farm facilities and farming activities. ■

GCP/RER/031/TUR Central Asia Regional Programme for Fisheries and Aquaculture Developments (Under FAO – Turkey Partnership Programme)

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Within the framework of the FAO Turkey Partnership Programme (FTPP), the Turkish Government, through its Ministry of Agriculture and Rural Affairs (MARA) provides assistance to the countries of the sub-region for which the FAO Sub-regional Office for Central Asia (SEC) is responsible within FAO, namely, Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey, Turkmenistan, and Uzbekistan.

Justification for and objectives of the Programme

Assistance in the rehabilitation process of the fisheries and aquaculture sector in Central Asia is urgently required as fisheries production and the availability of fish for consumption has decreased significantly in the last decades. Since the collapse of the Soviet Union in the beginning of the 1990s, when the Central Asian Republics became independent, the capture fisheries and aquaculture production has declined dramatically. The combined fish production (fisheries and aquaculture) in the five Central Asian republics fell from 158 thousand tonnes in 1991 to 43 thousand tonnes in 2001. In 2008 the production summed up to 77 thousand tonnes, of which only some 4 thousand tonnes originated from aquaculture. Causes for the collapse in capture fisheries and aquaculture production are similar to those found in many other Commonwealth of Independent States (CIS) countries, and include a mix of institutional, political, economic, social and technical factors.

The programme is structured in such a way that it can achieve within a five year period the following outcomes: 1) A formally established Central Asian and Caucasus Fisheries and Aquaculture Commission; 2) Strengthened fisheries and aquaculture sector policy, legal and institutional frameworks; 3) A Capacity building and education programme for fisheries and aquaculture professionals of the region established and functioning; and 4) Increased sustainability in the management of fisheries and aquaculture.

Programme Costs

The regional programme has a budget of USD 1.9 million over the five year lifecycle of the programme (from July 2009 to June 2014). The FAO Turkey Partnership Programme will cover USD 1.5 million, while the participating countries will contribute in-kind an estimated USD 400 thousand to the programme. Being an umbrella programme, the programme management will actively seek additional donor support to increase the scope and dissemination of the programmes' outputs and the outcomes foreseen.

What is the work-plan for 2010?

The following activities are included in the work-plan for 2010.

1. Regional Collaboration

The Second Steering Committee Meeting to prepare for the Third Intergovernmental meeting on the Establishment of the Central Asian and Caucasus Fisheries and Aquaculture Commission was held in Istanbul on 24-25 of February 2010 with support from the programme. The Third Intergovernmental meeting, which will take place on 6-8 September in Kyrgyzstan will also be supported by the programme.

2. Policy, legal and institutional framework support

The programme will support, on request of the Government of Tajikistan, the preparation of a National policy and strategy for fisheries and aquaculture development for poverty alleviation, in the period May-July 2010.

3. Capacity Building and education

The programme conducted on 12-14 January 2010 in Tashkent, Uzbekistan a "Regional Workshop to assess the fisheries and aquaculture sector education, training and research needs in Central Asia". Currently the programme team, consisting of many technical FAO staff, is following-up on the assessed needs. Some of the assessed needs will be supported in 2010, such as the following:

- Regional training workshop on fish and livestock feed nutrition and feed technology (Dushanbe, Tajikistan, 7-8 May 2010).

- Studytour on fish culture and fish processing in Thailand, organized in combination with the Aquaculture 2010 - Global Conference: Farming the Waters for Food and People (Phuket 22-25 September 2010) and the 5th session of the Committee on Fisheries (COFI) Sub-Committee on Aquaculture (Phuket, 27 September -1 October 2010) .

- Studytour to FutureFish Eurasia 2010, http://www.eurasiafairs.com/eng/index.html , Izmir, Turkey 16-18 September 2010, with visits to fish feed factories and fish farmers.

- Regional capacity building workshop on fishery and aquaculture statistics, information and trends: improving data collection analysis and dissemination. This workshop is scheduled to take place in Kazakhstan in the last quarter of 2010.

4. **Aquaculture development and management**
The programme has started to develop Better Management Practices (BMP) for carp production in ponds. Experts have been contracted, who are working on the draft BMP document and an expert workshop to discuss and finalize the BMPs will be organized in October 2010. Carp aquaculture has not developed much in the region in recent years and application of modern technologies and knowledge is low. For that reason this workshop and finally the BMP for carp aims to increase the total production of carp in the region.

Towards the end of the year, the Programme is planning an education tour on trout culture. Trout is an important species for the region. The education will include field studies in Turkey – Isparta and Mugla area. Most of the trout farms in Turkey get eggs from their broodstocks in December, thus it would suit best to organize the tour in December 2010. Well equipped trout farms that have complete hatchery facilities will present invited people unforgettable scenes.

More information can also be obtained from Mr Raymon van Anrooy (FAOSEC Fishery and Aquaculture officer) at
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Environmental Impact Assessment (EIA) and Monitoring in Aquaculture

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The FAO Technical Workshop on Environmental Impact Assessment (EIA) and Monitoring in Aquaculture was held in Rome in September 2008 as part of the FAO/Japan umbrella project "Towards sustainable aquaculture: selected issues and guidelines". The project component on EIA and monitoring in aquaculture focused, in particular, on the relevant regulatory requirements, practices, effectiveness and suggestions for improvements. It generated four regional reviews on EIA and monitoring in aquaculture in Africa, Asia-Pacific, Latin America, Europe and North America, a special study on EIA in salmon aquaculture, as well as a global review and synthesis which drew on the findings of the review papers, covering information from more than 35 countries. The workshop reviewed and discussed findings of all review and synthesis papers, as well as possible elements for policy guidelines.

All outputs including regional reviews and global synthesis, case studies, policy conclusions and the workshop report were published in:

FAO. 2009. Environmental impact assessment and monitoring in aquaculture. Requirements, practices, effectiveness and improvements. FAO Fisheries and Aquaculture Technical Paper. No. 527. Rome, FAO. 57p. (includes a CD-ROM containing the full document 648 pages).
Readers are invited to request the publication on CD-ROM from Uwe.Barg@fao.org or access the online version at: http://www.fao.org/docrep/012/i0970e/i0970e00.htm
ftp://ftp.fao.org/docrep/fao/012/i0970e/i0970e.zip

Regional Workshop on Methods for Aquaculture Policy Analysis, Development and Implementation in Selected Southeast Asian Countries

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The Regional Workshop on "Methods for aquaculture policy analysis, development and implementation in selected Southeast Asian countries" was held in Bangkok, Thailand, 9-11 December 2009 and co-organized by FAO and the Network of Aquaculture Centres in Asia and the Pacific (NACA). A total of 18 participants from Cambodia, Indonesia, Thailand, Myanmar, Philippines, Viet Nam and Malaysia attended the workshop. SEAFDEC and ASEAN secretariats were also represented. The purpose of the workshop was threefold: first, to respond to the request of the COFI Sub-Committee on Aquaculture III for FAO (New Delhi, 2006) to provide and disseminate information and advice on aquaculture policy formulation and implementation; second, to build capacity related to aquaculture planning and policy development by providing participants with methods for aquaculture policy analysis, formulation and implementation; and third, to further the work initiated during the FAO Expert Consultation on Improving Planning and Policy Development in Aquaculture (Rome, 2008) and follow-up on its recommendations.

Through a series of very informative presentations on the status of aquaculture planning in participating countries, discussions, group work and facilitated exercises, 6 essential characteristics of aquaculture policies were identified. These include: participation, achievability, accountability, continuity, monitoring and evaluation, and balancing goals. Participants were also encouraged to critically reflect on their own experiences through a Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis of the planning processes undertaken in their own countries and on the relevance of the contents of their aquaculture policies. Discussions led to the formulation of a number of recommendations to make the contents of the outline for a proposed FAO Technical Guidelines for aquaculture policy formulation and implementation more specific to Southeast Asian circumstances. The workshop also generated a number of ideas to lay the foundation for a common vision for aquaculture development in Southeast Asia, highlighting that such a regional capacity building process was also an opportunity to promote regional cooperation amongst aquaculture nations. Participants were requested to send to FAO through the Aquaculture Service (FIRA), or the Regional Office for Asia and the Pacific (RAP), their national policies or plans, even in local languages, once they have been officially approved by their governments (for most, in early 2010) towards the constitution of repository of aquaculture policies. This request should be extended to all those who are involved in national aquaculture planning.

Further information about the workshop and its outcomes are available in the Report of the Regional Workshop on Methods for Aquaculture Policy Analysis, Development and Implementation in Selected Southeast Asian Countries. Bangkok, Thailand, 9-11 December 2009. *FAO Fisheries and Aquaculture Report,* No. 928. Rome, FAO, 2010 or from Simon Funge-Smith or Cecile Brugere. ■

Workshops in Latin America: User-friendly Aquaculture Investment and Management Tool for Small- and Medium-scale Farmers

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As part of the programme "Regional and National Workshops on Aquaculture Planning at the Farm Level in Africa and Latin America", two workshops were recently conducted in Paraguay (March 2-4, 2010) and Costa Rica (March 15-17, 2010). The goal of the workshops was to conduct field evaluations of the "User-friendly Aquaculture Investment and Management Tool" developed by the Aquaculture Service (FIRA) of the FAO Fisheries and Aquaculture Department.

The above "Tool" is an interactive, user-friendly model designed within Excel which enables users to conduct a complete financial analysis of a proposed or already-functioning aquaculture operation. The "Tool" was designed in such a way that it requires no previous knowledge of economic concepts or advanced skills in the use of spreadsheets. When used properly, the "Tool" may provide valuable assistance to small- and medium-scale aquaculture producers for improving the financial management of their operations.

Briefly, it consists of a series of linked worksheets within a spreadsheet file. The first four worksheets ask from the user input data on production and economic characteristics of the aquaculture operation, including size of the farm, number of ponds, stocking densities, food conversion ratios (FCRs), survival rates, price of fingerlings and feeds, selling price, etc. The model also requires an estimate of the investment required to build the facility, including construction of grow-out units (e.g. ponds) and purchase of land and machinery. Based on the information provided, the last four worksheets of the model will produce a series of standard financial forms (enterprise budget, income statement, balance sheet and cash flow budget) that may be used to compile a business plan and support an agriculture loan application for the operation. The "Tool" also offers customized advice to the user based on the results of the analysis. This "Tool" was initially designed for the analysis of pond-based aquaculture, but further models will be developed to cover cage aquaculture and hatcheries.

The "Tool", developed in 2009, has been subjected to a series of field evaluations in a number of countries. During 2009, training workshops were conducted in Cameroon, Madagascar, Senegal, Sierra Leone, and Zambia. The participants in each country included aquaculture producers, government officials with responsibilities in aquaculture development, members of academia and representatives from local NGOs and the agricultural banking sector.

Paraguay and Costa Rica were selected as the field-testing countries in Latin America. The workshop in Paraguay was jointly organized with the Department of Aquaculture, Ministry of Agriculture and Livestock and took place at the computing facilities of the National University of Asunción. The workshop was attended by 36 participants. The workshop in Costa Rica was jointly organized with the Institute of Fisheries and Aquaculture (INCOPESCA) and was held at the Hotel Clarion Amón Plaza in San José. Twenty-nine participants attended the workshop.

In general terms, the "Tool" was very well received in each of the countries where it was presented. Participants rapidly learned how to interact with the "Tool" in an effective manner and realized the many ways the model could help them improve the management of their operations. Participants provided useful comments and suggestions that will be used to improve various aspects of the "Tool". Based on these modifications, a final version will be released and posted (in English, French and Spanish) on the FAO Fisheries and Aquaculture Department website during the second semester of 2010. For further information, please contact the above authors via e-mail. ■

Purcell, S.W. Managing sea cucumber fisheries with an ecosystem approach. Edited/compiled by Lovatelli, A.; Vasconcellos M. & Yimin. Y. *FAO Fisheries and Aquaculture Technical Paper.* No. 520. Rome, FAO. 2010. 157 pp.

Sea cucumbers are important resources for coastal livelihoods in more than 40 countries and most of the harvests are processed then exported to Asian markets. Sadly, widespread overexploitation of wild stocks risks biodiversity loss and the long-term viability of fisheries. Spawned from an FAO international workshop of experts, this document presents a "roadmap" to guide fishery managers in choosing appropriate regulatory measures and management actions for sea cucumber fisheries. It elaborates on their use, limitations and modes of implementation, with Examples and lessons learned from various fisheries. Sea cucumber fisheries differ greatly in the scale of the fishing activities, status of stocks and the capacity of the management agency. Consequently, some management measures will be appropriate in some fishery scenarios but not others. Achieving sustainable management of sea cucumber fisheries requires an ecosystem approach to fisheries (EAF), precautionary regulations, improved enforcement and stronger commitment of fishery managers and policy makers.
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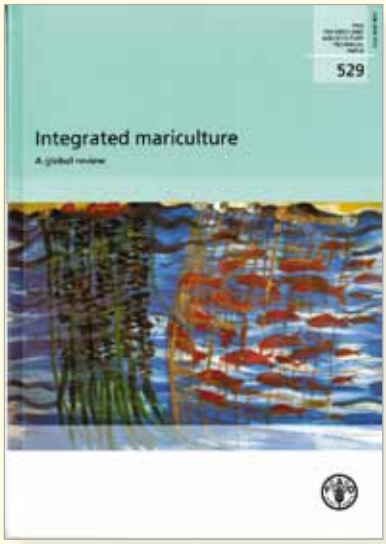

Soto. D. (ed.) Integrated mariculture: a global review: *FAO Fisheries and Aquaculture technical paper.* No. 529. Rome, FAO. 2009. 183 pp.

This technical paper provides a comprehensive review of current integrated mariculture practices around the world in three papers covering temperate zones, tropical zones and one semi-enclosed ecosystem, the Mediterranean Sea. Integrated mariculture includes a diverse range of co-culture/farming practices, from integrated multitrophic aquaculture to the more specialized integration of mangrove planting with aquaculture, called aquasilviculture. Modern integrated mariculture systems must be developed in order to assist sustainable expansion of the sector in coastal and marine ecosystems thus responding to the global increase for seafood demand but with a new paradigm of more efficient food production systems. Successful integrated mariculture operations must consider all relevant stakeholders into its development plan, there is also a need to facilitate commercialization and promote effective legislation for the support and inclusion of integrated mariculture through adequate incentives particularly considering the reduction of environmental costs associated to monoculture farming. Bioremediation of fed aquaculture impacts through integrated mariculture is a core benefit but the increase of production, more diverse and secure business and larger profits should not be underestimated as additional advantages.
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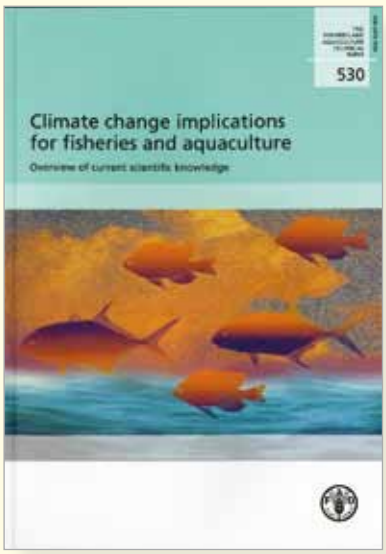

Cochrane, K.; De Young, C.; Soto, D. & Bahri, T. (eds.). Climate change implications for fisheries and aquaculture: overview of current scientific knowledge. *FAO Fisheries and Aquaculture Technical Paper.* No. 530. Rome, FAO. 2009. 212 pp.

This document provides an overview of the current scientific knowledge available on climate change implications for fisheries and aquaculture. It contains three technical papers that were presented and discussed during the Expert Workshop on "Climate Change Implications for Fisheries and Aquaculture" (Rome, 7–9 April 2008). A summary of the workshop outcomes as well as key messages on impacts of climate change on aquatic ecosystems and on fisheries- and aquaculture-based livelihoods are provided in the introduction. The first paper addresses climate variability and change and their physical and ecological consequences on marine and freshwater environments. The second paper tackles the consequences of climate changes impacts on fishers and their communities and reviews possible adaptation and mitigation measures that could be implemented. Finally, the third paper addresses specifically the impacts of climate change on aquaculture and reviews possible adaptation and mitigation measures that could be implemented.
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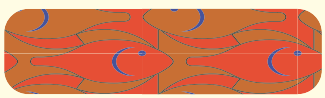

Rana, K.J.; Siriwardena, S. & Hasan, M.R. Impact of rising feed ingredient prices on aquafeeds and aquaculture production. *FAO Fisheries and Aquaculture Technical Paper*, No. 541. Rome, FAO. 2009. 63 pp.

The present technical paper investigates and evaluates the underlying reasons for the recent dramatic rise in prices of many of the commodities commonly used in aquafeed production and its consequences for the aquafeed industry, with particular reference to Asia and Europe. This paper also discusses issues related to availability and access to land and water resources, and the impact of other sectoral users of these resources on the direction of aquaculture in terms of production systems and the species produced. In view of increase in competition for land and water in major aquaculture producing countries in Asia, there will inevitably be increasing pressure to improve aquaculture productivity through intensification by using more of commercial feeds than farm-made feeds. Because of the increasing prices of ingredients, the prices of commercial compound aquafeeds may increase further and the shortfall in their local supply will compel imports. Among the ingredients, fishmeal and fish oil are highly favoured in aquafeeds and are under increasing pressure caused by limited supplies and increasing prices. Considering these factors, this paper also points out initiatives which search for substitution of fishmeal and fish oil to position the industry to meet the challenge of securing aquafeed for sustaining aquaculture. A brief overview of coping strategies to strengthen national capacity to address aquafeed supply and to mitigate rising aquafeed ingredient prices in terms of policies, research and private sector and farmers' initiatives are given.
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Aguilar-Manjarrez, J.; Kapetsky, J.M. & Soto, D. The potential of spatial planning tools to support the Ecosystem approach to aquaculture. FAO/Rome. Expert Workshop. 19–21 November 2008, Rome, Italy. *FAO Fisheries and Aquaculture Proceedings.* No.17. Rome, FAO, 2010, 176 p.

Attention is presently turning to the processes, methods and toolsthat allow practical implementation of the ecosystem approach toaquaculture (EAA). This will require the use of various tools andmethodologies, including environmental impact assessments andrisk analysis. Ecosystem-based management involves a transitionfrom traditional sector-by-sector planning and decision-makingto the more holistic approach of integrated natural resourcemanagement at different scales and for ecosystems that crossadministrative boundaries. An essential element for theimplementation of the EAA will be the use of spatial planningtools including Geographic Information Systems, remote sensingand mapping for data management, analysis, modelling anddecision-making. These proceedings focus on the status and processof implementing these tools which, in turn, necessitate thedevelopment of capacity building, training and promotion ofspatial planning among decision-makers and technical staff. Thedocument is organized in two parts. The first, the workshop report,deals with the background of the EAA effort and the genesis of theworkshop. Most importantly, it captures the salient contributions ofparticipants from their formal presentations and general discussions.The main conclusions of a review of the status and potentialof spatial planning tools, decision-making and modelling inimplementing the EAA are also included. The review itself,along with an abstract, forms the second part.
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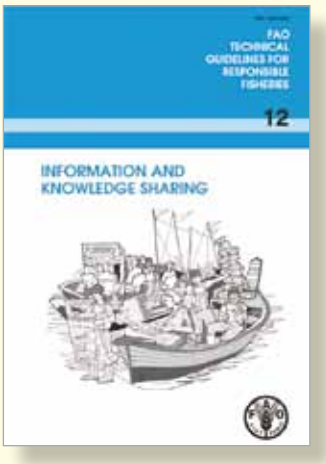
Russian versions of:
FAO Fisheries Department. Aquaculture Development. 1. Good aquaculture feed manufacturing practice. *FAO Technical Guidelines for Responsible Fisheries.* No. 5, Suppl. 1. Rome, FAO. 2001. 47 p.

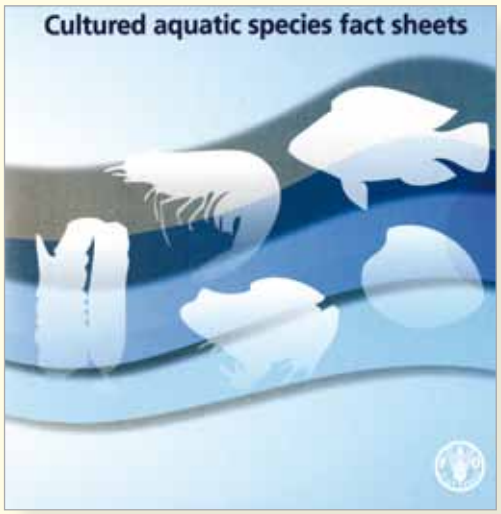
FAO Fisheries Department. Aquaculture Development. *FAO Technical Guidelines for Responsible Fisheries.* No. 5. Rome, FAO. 1997. 40 p.

The French and Spanish versions of:
FAO. 2008. Aquaculture development. 5. Genetic resource management. *FAO Technical Guidelines for Responsible Fisheries.* No. 5, Suppl. 3. Rome, FAO. 2008. 125p.

FAO. 2009. Développement de l'aquaculture. 3. Gestion des ressources génétiques. FAO Directives techniques pour une pêche responsable. No. 5, Suppl. 3. Rome, FAO. 160 p.

FAO. Desarollo de la acuicultura. 3. Gestión de recursos genéticos. *FAO Orientaciones Técnicas para la Pesca Responsable.* No. 5, Supl. 3. Roma, FAO. 2009. 148 p.





FAO. Information and knowledge sharing. *FAO Fisheries Technical Guidelines for Responsible Fisheries.* No. 12. Rome, FAO. 2009. 97 p. (Available also in Chinese, French and Spanish) .

These guidelines expand upon the information and knowledge aspects referred to throughout the 1995 FAO Code of Conduct for Responsible Fisheries. They highlight the issues involved for individuals and organizations to have access to the information they need and, as importantly, to share their own information and knowledge with others. The issues can be as diverse as information policy frameworks and information and communication technology infrastructure, each contributing to the essential flow of information between stakeholders. Particular attention is paid to the needs of developing countries, many of which continue to express concern that the lack of access to timely, relevant and accurate information is a serious constraint to the implementation of the Code. The resources and skills required for the creation, production, dissemination and availability of information and knowledge, its effective use and sharing by the present generation as well as its preservation for the future are often underestimated or even overlooked when new activities are being planned. These guidelines focus on information and knowledge sharing and the urgent need to address those areas which continue to constrain implementation of the Code.

For further information on the FAO Technical Guidelines for Responsible Fisheries Series, please contact :
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This CD-ROM contains 50 cultured aquatic species fact sheets produced by the Fisheries and Aquaculture Department of the Food and Agriculture Organization of the United Nations. The fact sheets are written in simple technical language and focus on the practical aspects of aquaculture, from seed supply to farming systems including harvesting techniques and marketing issues. All fact sheets are available in five FAO languages (Arabic, Chinese, English, French and Spanish), divided by groups of species and easily accessible through an introductory page and printable. The CD-ROM content is also available online at: ftp://ftp.fao.org/FI/DOCUMENT/aquaculture/CulturedSpecies/index.htm
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FAO Aquaculture publications 1999-2008

This USB pen drive contains a new FAO collection, produced by the Aquaculture Service of the FAO Fisheries and Aquaculture Department, consisting of all FAO aquaculture publications prepared during the decade 1999-2008. The collection has been prepared for the "Global Conference on Aquaculture 2010" (09-12 June 2010 in Bangkok, Thailand).
More than five hundred publications related to aquaculture, including CD-ROMs, web-based products and newsletters have been published and distributed worldwide during that time, in both hard and electronic versions and in various FAO official languages. All these publications have been assembled on this USB pen drive in order to make them easily available, printable and searchable to all users.
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FAN

FAO Aquaculture Newsletter

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The FAO Aquaculture Newsletter (FAN) is issued three times a year by the Aquaculture Service (FIRA) of the FAO Fisheries and Aquaculture Department, Rome, Italy. It presents articles and views from the FAO aquaculture programme and discusses various aspects of aquaculture as seen from the perspective of both headquarters and the field programme. Articles are contributed by FAO staff from within and outside the Fisheries and Aquaculture Department, from FAO regional offices and field projects, by FAO consultants and, occasionally, by invitation from other sources. FAN is distributed free of charge to various institutions, scientists, planners and managers in member countries and has a current circulation of about 1 500 copies.
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