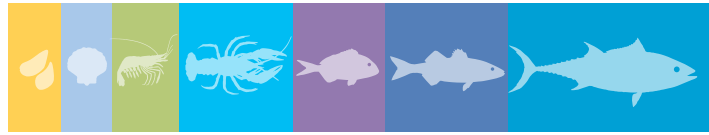




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FAO Aquaculture Newsletter



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Aquaculture facility in arid lands in Egypt

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Opportunities for Aquaculture Development in Drylands

Aquaculture the fastest growing major food industry for decades, currently produces 53 percent of the global fish we consume and it is largely responsible for doubling the per capita fish consumption of fish products since 1960s (SOFIA, 2018)¹. The global population growth and increase in food demand is driving the rapid development and intensification of aquaculture towards new geographical frontiers.

When we consider expansion of the sector as a whole, we immediately think of offshore aquaculture due to the large extension of the oceans and areas with limited conflicts of use. However, the development

of offshore aquaculture usually requires high initial costs and investments not always affordable by small-medium scale investors and at times, not technically feasible nor economically attractive. Although marine aquaculture offers great opportunities for development in term of high value species, revenues and creation of employment it may not, at least for now, fill the gap of fish needs of those populations living in inland marginal regions such as arid lands.

Drylands take up 41.3 percent of the world land surface and up to 44 percent of all the world's cultivated systems are in the drylands (United Nations)². Thirteen percent

of the world population (313 million) lives in arid zones with 92 million residing in hyper-arid deserts (UNDP/UNSO). Deserts cover more than one fifth of the Earth's land, they are found on every continent and they can represent new unexploited areas for development.

Arid lands are characterized by high temperature variations (between day and night); low precipitations; high solar radiation and evaporation; limited surface water; abundant inexpensive land; often with large aquifers of fresh and brackish water. Ground water in these environments is often only partially used although this water is abundant and of high quality.

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Fish market in Kuwait City, Kuwait

Nowadays drylands can be better exploited for food production using modern and responsible aquaculture practices such as integrated aquaculture systems which follow agroecology principles³, reducing water use in support to food safety and environmental protection and conservation. These integrated farming systems can produce a cheap and affordable source of quality protein and fresh vegetable products with reduced water and resources use especially small-scale farm households in rural areas. Integrated multi-trophic aquaculture (IMTA)⁴ also offers the opportunity to produce high quality crops taking advantage of synergistic interactions among the species. Also, renewable energy such as solar, geothermal and wind power allows the intensification of production without depending on standard sources of energy.

In the last two decades, the integration of aquaculture with

agriculture has become more popular in areas where water and other resources are limited. Aquaculture

in arid lands can provide social benefits, assuring an improved public health and food security for rural communities reducing migration of vulnerable population especially youth and women, towards cities and/or abroad.

In these areas aquatic food does not easily reach local markets and there is a low tradition in fish consumption. Moreover available fish is often in the form of frozen products (sardines or tilapia) and often of poor quality. People are usually not aware of the high nutritional value of fresh fish and the role fish plays in the optimal development of the brain and neural system of children.

In many countries of the Near East and North Africa, governments are strongly supporting the development of freshwater aquaculture particularly in marginal regions such as desert and arid lands. The increasing competition for land, water and natural resources will require the application of new strategies including promotion of efficient use of resources, recycling and enhancing biodiversity to ensure adequate food production protecting livelihoods and social systems and promoting responsible governance.

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SEE ALSO

1. FAO. 2018. *The State of World Fisheries and Aquaculture 2018* - Meeting the sustainable development goals. Rome. www.fao.org/3/i9540en/i9540EN.pdf
2. United Nations webpage: www.un.org/en/events/desertification_decade/whynow.shtml
3. FAO Agroecology Knowledge Hub: www.fao.org/agroecology
4. Integrated Multi-trophic Aquaculture https://link.springer.com/referenceworkentry/10.1007%2F978-1-4614-5797-8_173



Women visiting an aquaculture facility in the District of Ouargla, Algeria

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Farmed Nile tilapia (*Oreochromis niloticus*) in Oman

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Fish market in Kuwait City, Kuwait

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Fish ponds in the Bay of Cadiz, Spain

GLOBAL AQUACULTURE UPDATES



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Overview of Recently Published Global Aquaculture Statistics

Global aquaculture production (including aquatic plants) in 2016 was 110.2 million tonnes, with the first-sale value estimated at USD 243.5 billion. The first-sale value, re-estimated with newly available information for some major producing countries, is considerably higher than previous estimates. In general, FAO's data for aquaculture production volume are more accurate and reliable than those for value. The total production included 80.0 million tonnes of food fish (USD 231.6 billion) and 30.1 million tonnes of aquatic plants (USD 11.7 billion) (Figure 1) as well as 37 900 tonnes of non-food products (USD 214.6 million). Farmed food fish production included 54.1 million tonnes of finfish (USD 138.5 billion), 17.1 million tonnes of molluscs (USD 29.2 billion), 7.9 million tonnes of crustaceans (USD 57.1 billion) and 938 500 tonnes of

other aquatic animals (USD 6.8 billion) such as turtles, sea cucumbers, sea urchins, frogs and edible jellyfish. Farmed aquatic plants included mostly seaweeds and a much smaller production volume of microalgae. The non-food products included only ornamental shells and pearls. As of 2016, global production has been recorded for a total of 598 "species items" ever farmed in the world. The share of unfed species in total aquatic animal production decreased gradually from 2000 to 2016, shrinking by 10 percentage

points to 30.5 percent. Since 2000, world aquaculture no longer enjoys the high annual growth rates of the 1980s and 1990s (10.8 and 9.5 percent, respectively) (Figure 2). Nevertheless, aquaculture continues to grow faster than other major food production sectors. Annual growth declined to a moderate 5.8 percent during the period 2001-2016, although double-digit growth still occurred in a small number of individual countries, particularly in Africa from 2006 to 2010. China, by far the major producer of farmed

Extracted from the *FAO State of World Fisheries and Aquaculture 2018*

FIGURE 1
WORLD AQUACULTURE PRODUCTION OF FOOD FISH AND AQUATIC PLANTS, 1990–2016

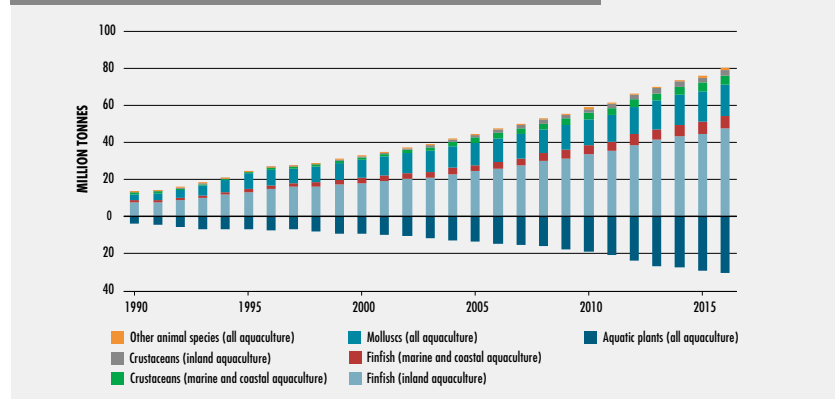
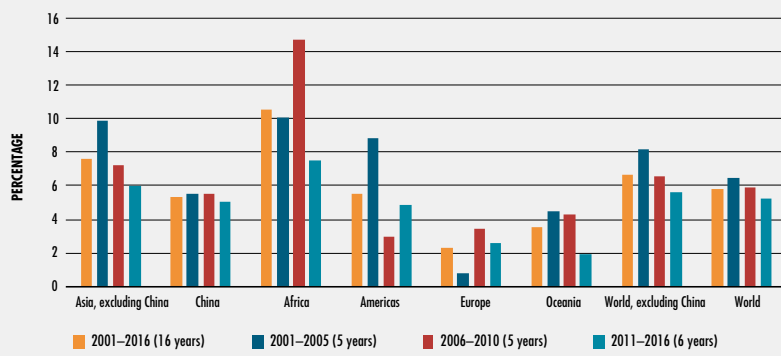


FIGURE 2
AVERAGE ANNUAL GROWTH RATE OF AQUACULTURE PRODUCTION BY VOLUME
(excluding aquatic plants)



food fish in 2016, has produced more than the rest of the world combined every year since 1991. The other major producers in 2016 were India, Indonesia, Viet Nam, Bangladesh, Egypt and Norway. China and Indonesia were by far the major producers of aquatic plants in 2016. World production of farmed food fish relies increasingly on inland aquaculture, which was the source of 51.4 million tonnes of food fish, or 64.2 percent of the world's farmed food fish production, as compared with 57.9 percent in 2000.

The contribution of aquaculture to the global production of capture fisheries and aquaculture combined (excluding aquatic plants) has risen continuously, reaching 46.8 percent in 2016, up from 25.7 percent in 2000. If China is excluded, aquaculture's share reached 29.6 percent in 2016, up from 12.7 percent in 2000. At the regional level, aquaculture accounted for 17 to 18 percent of total fish production in Africa, the Americas and Europe, followed by 12.8 percent in Oceania. The share of aquaculture in Asian fish production (excluding China) increased to 40.6 percent in 2016, up from 19.3 percent in 2000 (Figure 3). In 2016, 37 countries were producing more farmed than wild-caught fish. These countries are in all regions except Oceania, and collectively they account for close to half of the world's human population. Aquaculture accounted

for less than half but over 30 percent of national total fish production in another 22 countries in 2016. Lack of reporting by about 35 to 40 percent of the producing countries, coupled by insufficient quality and completeness in some of the reported data, hinders FAO from presenting a clearer and more detailed picture of world aquaculture development status

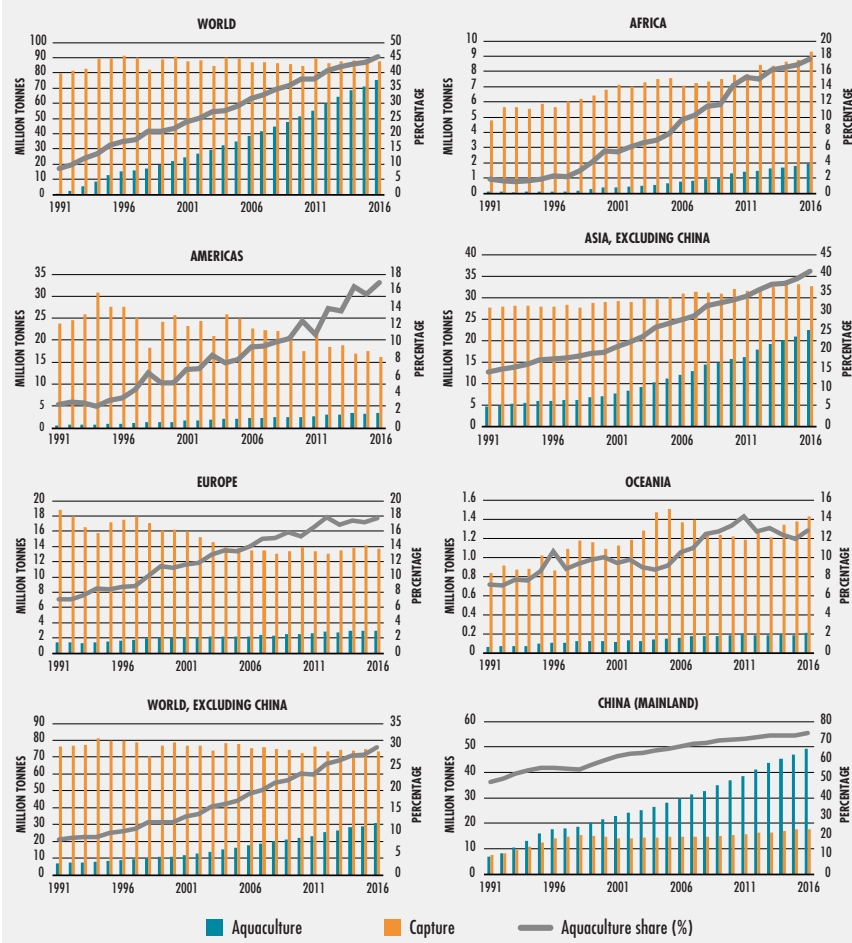
and trends. FAO received just below 120 national data reports for the 2016 reference year, representing 84.3 percent (67.5 million tonnes, excluding aquatic plants) of total food fish production by volume; however, if China is excluded the percentage is much lower. FAO estimates for the non-reporting countries account for 15.1 percent (12.1 million tonnes) of the total production. The remaining data are official statistics collected on an *ad hoc* basis from a few countries that did not respond officially to FAO's request for national data.



SEE ALSO

FAO. 2018. *The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals*. Rome. www.fao.org/3/i9540en/i9540EN.pdf

FIGURE 3
AQUACULTURE CONTRIBUTION TO TOTAL FISH PRODUCTION (excluding aquatic plants)



FAO Continues Efforts to Build Capacity in Dealing with Tilapia Lake Virus

Since the article on Tilapia Lake Virus (TiLV) was released in the 57th (September 2017) issue of FAN, FAO had continued its efforts assisting FAO member states and other stakeholders in addressing the risk of TiLV. The geographical distribution of TiLV, reported through the World Organization for Animal Health (OIE) notification, grey and scientific literature reports as well as information from producer sectors showed that TiLV occurrence have now increased and expanded to tilapia producing regions (Asia, Africa and Latin America); at least 14 countries were included in these reports. TiLV spread is likely a direct one through local and transboundary movement of live fish. As live tilapia is a widely traded commodity, there is potential that TiLV may have spread significantly over the years since its first reported occurrence in 2009.

An enveloped, negative-sense, single stranded RNA virus, TiLV appears to have a narrow host specificity [e.g. farmed tilapia such as hybrid tilapia (*Oreochromis niloticus* x *O. aureus* hybrid), Nile tilapia, and red tilapia (*Oreochromis* sp.)] and reported as well from several wild tilapines. There are recent reports that other freshwater fish species are susceptible. Histopathology,



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Nile tilapia (*Oreochromis niloticus*) infected by TiLV

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RT-PCR and RT-qPCR, and *in-situ* hybridization are currently the methods that can be used to identify TiLV. The most common histopathological lesion found in TiLV outbreaks is syncytial hepatitis. Although the precise mechanism for transmission is unknown, nor is there information available on virus stability free in the water or in contaminated fomites, horizontal disease transmission is likely to be the main mode of disease spread. There is still lacking information on the role played by the trade in uncooked tilapia products, both in terms of the virus' survival in frozen/chilled tissue or in terms of pathways by which these products could result in infection of farmed or wild fish stocks.

FAO continues to provide technical assistance to enhance the understanding about the disease and find mitigation and management measures to reduce the risk of further spread. Some of these efforts are described below.

Intensive 7-day training course on TiLV, 18-24 June 2018, Guangzhou, China

A collaborative capacity building initiative between China's National Fisheries Extension Center (NFTEC) and Sun Yat-Sen University (SYSU) and FAO, was successfully concluded on 24 June 2018. The course was opened by Dr Jianguo He (SYSU) and closed by Dr Feng Zang and Ms Qing Li (NFTEC). Some 29 participants representing competent authorities, academe and service providers from Brasil, China, Indonesia, Malaysia, Mozambique, Myanmar, Peru, the Philippines, Sri Lanka and Viet Nam completed the intensive course. Under the technical oversight of FAO (Dr Melba Reantaso), the course was delivered by Chinese (Dr Yang Hong, Prof Anxing Li, Dr Hong Liu and Prof JunHong Xia) and FAO experts (Dr Kathy F.J. Tang, USA; Dr Win Surachetpong, Thailand; Dr Ha Thanh Dong, Viet Nam; Dr Mona D. Jansen,

Norway). The course consisted of seven sessions that included 22 expert presentations, field visit, laboratory activities and several interactive working group exercises. The participants acquired the currently available technical information on the biology, pathology, diagnostics, surveillance and economics, farm level management of TiLV and emergency preparedness. These learnings reinforced their capacity in preparing a preliminary action plan on TiLV. All materials used during the course can be found in this link: www.fao.org/fishery/nems/41072

TiLV Expert Knowledge Elicitation (EKE) Risk Assessment

This risk assessment (RA) initiative had the following objectives: (i) to determine the extent of biosecurity risks associated with the spread of TiLV into TiLV free zones/countries and spread within countries where the disease is already established; and (ii) to identify biosecurity measures to manage these risks. The RA was intended to serve as a guide to assist countries in setting risk management policies that address concerns about the potential spread of TiLV. The scope of this assessment was restricted to an estimation of the risks associated with the intra-national or international movement of live fish, or the trade in raw chilled or frozen whole fish or fish products. The method used was a standardised EKE methodology developed by FAO's Global Early Warning System (GLEWS) to improve the capacity to identify, assess and respond to animal health events that could affect livestock, wildlife, food

security or food safety (FAO-GLEWS Rapid Risk Assessment Guidelines, in process), and draws on previous FAO rapid risk analyses on Rift valley fever virus¹ and the Highly pathogenic avian influenza virus². The method used the following steps: (i) reviewed the risk assessment (RA) done for livestock diseases as reference for developing the RA for TiLV; (ii) prepared TiLV risk profile based on available information; (iii) developed the RA questionnaires; (iv) assembled a list of experts and made a call for participation; (v) collated and analysed the expert responses to the questionnaires; (vi) results reviewed by an FAO team prior to sending back to experts for final assessment. The report of the assessment will be released before end of the year.

Ongoing and pipeline technical cooperation projects on TiLV

The African Solidarity Trust Fund (ASTF) is funding the project titled: "Enhancing capacity/risk reduction of emerging TiLV to African tilapia aquaculture". Six countries (e.g. Angola, Egypt, Ghana, Kenya, Nigeria and Uganda) are participating. The objectives of this project are to: (i) strengthen aquaculture biosecurity governance and knowledge and capacities on TiLV pathology, diagnostics, surveillance, emergency preparedness, contingency plans and adoption of farm-level TiLV biosecurity and tilapia good farming practices through a National Action Plan on TiLV; and (ii) exchange knowledge and establish networking support to aquaculture biosecurity and Aquatic Animal Health (AAH) management among participating

countries and experts. The expected project outcomes are: (i) effective biosecurity governance through well-planned TiLV national action plans to reduce the negative impacts of the disease; and (ii) information and knowledge on good and effective aquaculture biosecurity and Aquatic Animal Health (AAH) management practices are shared among the participating African countries. Another pipeline project under FAO's technical cooperation programme (i.e. interregional TCP) is being developed and will focus on selected countries in Asia and Latin America with similar objectives as that of the ASTF funded project. An International Technical Seminar on TiLV is being planned for 2020; this will provide a forum for participating countries of these two projects and other stakeholders doing work on TiLV to present their findings and exchange information and experiences to better understand TiLV as basis for finding solutions.

Note

It is paramount for tilapia producing countries to assess risks, undertake surveillance to determine national TiLV health status, investigate unexplained tilapia mortalities and introduce risk management measures where deemed necessary. The status of TiLV in a country can be politically sensitive due to the range of potential implications. It is thus essential that competent authorities are immediately informed of any observation (field or research) before such findings are made publicly available.

1 Food and Agriculture Organization of the United Nations (FAO). 2017a. Rift Valley Fever in Niger: Risk assessment. FAO Animal Health Risk Analysis – Assessment, Issue No. 1. Rome, FAO. www.fao.org/3/a-i7055e.pdf

2 Food and Agriculture Organization of the United Nations (FAO). 2017b. H5N8 HPAI in Uganda. Further Spread in Uganda and Neighbouring Countries (February 2017). FAO Animal Health Risk Analysis - Assessment, Issue No. 2. Rome, FAO. www.fao.org/3/a-i7105e.pdf

Thirty-third Session of the FAO Committee on Fisheries (COFI 33)

The Committee on Fisheries (COFI), a subsidiary body of the Food and Agriculture Organization of the UN (FAO) Council, was established by the FAO Conference at its Thirteenth Session in 1965. The Committee is a global inter-governmental forum where major international fisheries and aquaculture problems and issues are examined and recommendations addressed to governments, regional fishery bodies, NGOs, fishworkers, FAO and the international community. COFI has also been used as a forum to negotiate global agreements and non-binding instruments.

The two main functions of COFI are to review the programmes of work of FAO in the field of fisheries and aquaculture and their implementation, and to conduct periodic general reviews of fishery and aquaculture problems of an international character and appraise such problems and their possible solutions with a view to concerted action. The Committee also reviews specific matters relating to fisheries and aquaculture referred to it by the Council or the Director-General of FAO, or placed by the Committee on its agenda at the request of Members, or the UN General Assembly.

The Committee on Fisheries (COFI) held its thirty-third session in Rome from 9 to 13 July 2018. The session was attended by 114 Members of the Committee, by observers from eight other FAO Member Nations, the Holy See and Palestine, and one Associate Member of FAO, by representatives from ten specialized agencies and related organizations of the United Nations and by observers from 44 intergovernmental, one Consultative Group on International Agricultural Research (CGIAR) and 33 international non-governmental organizations.

The Committee adopted the Agenda and Timetable for the session with the addition of two items: (1) Report from the Republic of Korea on the progress of the pilot programme for the World Fisheries University; and (2) A proposal for the establishment of a new sub-committee on fisheries management. The Agenda and the list of documents which were placed before the Committee are available in this link:

www.fao.org/about/meetings/cofi

Specific actions to be taken by FAO to follow up on the decisions and recommendations by COFI 33 that are specific to the Ninth Session of the COFI Sub-Committee on Aquaculture, Rome, 24-27 October 2017 include:

- Support for the Blue Growth Initiative, as a strategy for the sustainable development of fisheries and aquaculture, and recognition of the Common Vision for Food and Agriculture as a useful framework to support the sustainable growth of aquaculture.
- Develop sustainable aquaculture guidelines to provide guidance to the sector.
- Finalize and distribute The State of the World's Aquatic Genetic Resources for Food and Agriculture.
- Develop a global information system, including a registry of species, to monitor and assess the status

of aquatic genetic resources relevant to aquaculture.

- Continue work with the World Organisation for Animal Health, noting the development of the progressive management pathway towards better biosecurity in aquaculture, and the need to build the capacity of Members to better manage their biosecurity issues.
- Increase attention to aquaculture production in inland areas, diversification of aquaculture, protection of aquatic biodiversity and native species, selective breeding, as well as extension services to support inclusive strengthening of value chains.
- Improve consumer perception of the aquaculture sector.
- Continue work on aquaculture development in Small Island developing States.
- Strengthen the capacity of small-scale producers to attain certifications to secure and improve market access.
- Hold a global conference on aquaculture in 2020, and collaborate with preparations, building upon the successful experiences of similar conferences in 2000 and 2010.
- Support the transfer of the Aquaculture Network for Africa initiative to the African Union Inter-African Bureau for Animal Resources and continue to support the network.

The tenth session of the Sub-Committee on Aquaculture will take place in Norway in 2019.



SEE ALSO

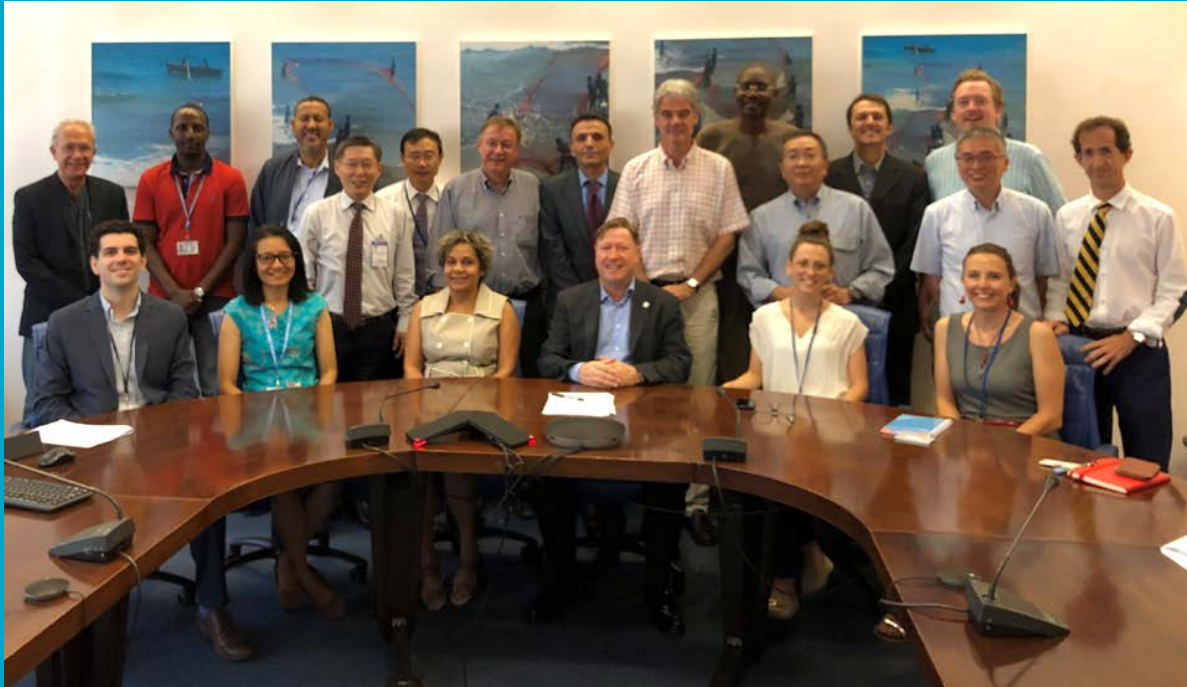
SOFIA 2018 digital report:
www.fao.org/state-of-fisheries-aquaculture



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Meeting between the Aquaculture Branch Staff and the FAO Decentralized Officers



Group photo of the Aquaculture Branch staff and the FAO decentralized staff

The Committee on Fisheries (COFI) met in July 2018 at FAO Headquarters (HQ) in Rome, Italy. COFI is a major global intergovernmental event and presents a great opportunity for FAO staff and delegates to meet with many of the global leaders in fisheries and aquaculture. It is also a good and unique occasion to get together among FAO HQ and FAO's decentralized staff based in regional and sub-regional FAO offices to exchange latest news and developments and planning our joint contribution to future aquaculture development. This year, Matthias Halwart the newly appointed *Acting Head* of the Aquaculture Branch, introduced himself as

well as three recently recruited Senior Aquaculture Officers to staff from the regions (see FAN 58, April 2018). He provided his vision for future aquaculture growth and his expectations for strong collaboration and partnership. For the short and medium term, Matthias stressed the need for a concerted push for collaboration with a broad range of partners through the Global Aquaculture Advancement Partnership Programme and the strengthening of aquaculture in our work with FAO members including an enhanced use of the results of the Code of Conduct for Responsible Fisheries (CCRF) reporting for the development of guidance on sustainable aquaculture growth. He emphasized major milestones coming up soon such as the global report on *The State of the World's Aquatic Genetic Resources for Food and Agriculture*. Decentralized officers appreciated shared updates on aquaculture development in their respective regions. Our next meeting is planned at the margins of the 10th Session of the COFI Sub-Committee on Aquaculture scheduled to be held in Trondheim Norway from 22 to 26 August 2019.



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Advancing Integrated Agriculture-Aquaculture through Agroecology

During the recent World Aquaculture Society - European Aquaculture Society's AQUA 2018 International Conference in Montpellier, France (25-29 August 2018), FAO convened a special session on agroecology and its relevance to Integrated Agriculture-Aquaculture (IAA), with support from Cirad (Centre de Coopération Internationale en Recherche Agronomique pour le Développement) and NACA (Network of Aquaculture Centres of Asia-Pacific).

Whereas traditional aquaculture, as practised for thousands of years in Asia, has always been perfectly integrated into its natural, agricultural and human environment, new approaches are currently emerging with the objective of furthering and sustaining the sector growth. Examples include aquaponics (combining aquaculture and hydroponics), integrated multi-trophic aquaculture (combining polluting species with extractive species and crops such as filter-feeding molluscs or macroalgae), insect farms to feed fish, or the use of lumpfish (*Cyclopterus lumpus*) to control sea lice in salmon.



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Árni Mathiesen (Assistant Director General of FAO Fisheries and Aquaculture Department) and Elisabeth Claverie de Saint Martin (Director General of CIRAD) during the opening of the workshop

Agroecology is a new approach based on ecological concepts that aims at optimizing interactions between plants, animals, humans and the environment while taking into consideration ecosystem services and the social aspects that need to be addressed for a sustainable and fair food system. It is characterized by 10 principles developed by FAO in line with its Common Vision for Sustainable Food and Agriculture and as in other fields of agriculture, it is one of the most promising avenues for inventing a new resilient and sustainable aquaculture, but also for helping the sector to adapt to climate change.

The special session took place on Saturday 25th August, where 25 guest speakers from Asia,

Africa, Europe and Latin America provided expert reviews and case studies covering a wide spectrum of agroecological aquaculture as it is currently practised throughout the world.

The workshop was the first gathering of so many participants for discussions related to IAA and agroecology. With over 100 external persons registered, it also created a large interest among the participants of the International conference. The next step will consist of publishing the proceedings and conclusions of the workshop.



SEE ALSO

Agroecology Knowledge Hub:
www.fao.org/agroecology



Rice-fish farming in Madagascar

FAO Presence at AQUA 2018 Conference in Montpellier

The AQUA 2018 conference (www.was.org/meetings) was organized by the World Aquaculture Society (WAS) and the European Aquaculture Society (EAS) and it was held in the city of Montpellier from 25 to 29 August 2018. The event brought together more than 3 000 participants from over 100 countries and more than 200 exhibitors representing stakeholders from every segment of the global aquaculture production and marketing chain, and included academics, students, representatives from every ancillary industry, and others.

FAO's tasks were to give one keynote presentation on "FAO Update on the Status of World Aquaculture 2018", chair four sessions, and deliver six thematic presentations.

Sessions chaired by FAO

1. FAO-CIRAD-NACA Special Session on Advancing Integrated Agriculture Aquaculture through Agroecology.
2. Biodiversity, Conservation and Alien Species.
3. Biosecurity and Antimicrobial Resistance.
4. Marine Spatial Planning (zoning, site selection, area management, and spatial technologies).

Presentations delivered by FAO

1. FAO perspectives at the EU Session on Food and Value Creation from the Atlantic Ocean.
2. The State of the World's Aquatic Genetic Resources.
3. The Aquaculture Biosecurity Progressive Management Pathway.
4. Spatial technologies for disaster risk management in aquaculture.
5. An overview on aquaculture in desert and arid lands.
6. Efficient use of resources for the successful development of aquaculture the desert and arid lands.

Additionally, FAO managed an exhibition booth at the Corum Congress Centre to disseminate FAO's information products and to provide a live PC demonstration on FAO's World Aquaculture Performance Indicators tools (WAPI).

Among the key achievements/agreements derived from FAO's attendance at the conference are *inter alia*:

- Strengthened ties with World Aquaculture Society and European Aquaculture Society including through regular keynote openings by FAO.



FAO staff members attending the AQUA conference

- Reinforced promotion and dissemination of FAO's aquaculture activities and publications.
- Deepened collaboration between FAO and CIRAD (The French agricultural research and international cooperation organization working for the sustainable development of tropical and Mediterranean regions).
- Interest from NOAA in further dialogue on Ocean aquaculture and Marine Spatial Planning.
- Confirmed interest to work with the European Union from across their various directorates, and to engage in a dialogue on supporting the FAO Sub-Committee on Aquaculture intersessional periods and specifically the Sustainable Aquaculture Guidelines (SAG) process.
- Confirmed interest from China/Shanghai Ocean University and Tianjin University to collaborate with the FAO Aquaculture Branch on integrated agriculture-aquaculture.
- Proposal received from Stirling University for FAO to become a project partner.
- Innovative ideas on Millennium +20 Conference framed.



FAO stand at the Aqua 2018 Conference



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Symposium on Lessons from Two High CO₂ Worlds - Future Oceans and Intensive Aquaculture

From the 10th to 12th of April, the symposium “Lessons from Two High CO₂ Worlds: Future Ocean and Intensive Aquaculture” was held in São Miguel in the Azores, Portugal, organized by Dr Robert Ellis and Professor Rod Wilson from the University of Exeter, as well as co-organizers from Chile, Canada and Norway. Supported by the Society of Experimental Biology (SEB), in association with the FRCT (Azores Government), the meeting aimed to bring further awareness to the shared issue of elevated CO₂, faced increasingly by the world’s oceans and across (intensive) aquaculture production. Exponentially rising CO₂ (currently ~400 µatm) is driving climate change, and causing acidification of both marine and freshwater environments. Physiologists have long known that CO₂ directly affects acid-base and ion regulation, respiratory function, and aerobic performance. More recently, many studies have demonstrated that elevated CO₂ projected for end of this century (e.g. 800-1 000 µatm) has dramatic effects on behaviors linked to sensory stimuli (smell, hearing and vision), that have negative implications for fitness and survival across aquatic environments. Nonetheless, some sectors of the aquaculture industry were farming aquatic animals at extremely high CO₂ levels (>10 000 µatm) long before the term “ocean acidification” was coined, and continue to do so with limited detrimental effects reported. It is therefore vital to understand the mechanisms behind this apparent variability in resilience to high CO₂ across settings, and the striking disparity in the perception of this global stressor across two critically important research fields. The symposium highlighted many valuable insights that the two communities can offer one another across marine and freshwater settings, and the shared learning that greater cross-disciplinary collaboration can afford. The



Hand feeding gilthead seabream (*Sparus aurata*) in a floating cage in Porto Farina, Tunisia

latest research also highlights the important role elevated CO₂ may play in impacting aquaculture productivity, even at relatively ‘low’ levels considered in an aquaculture context. Further knowledge on CO₂ impacts are thus a critical consideration for intensification of aquaculture production.

FAO participation at this conference provided an opportunity to gain insight on present and future scientific research being conducted on the issue of elevated CO₂, across climate change and aquaculture fields. It was also an opportunity to present the FAO aquaculture perspective towards the sustainable growth of the sector, and to engage and find common issues that can be worked within FAO goals for a sustainable growth in aquaculture in the face of a changing climate.



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SEE ALSO

Lessons from two high CO₂ worlds - future oceans and intensive aquaculture. www.sebiology.org/events/event/lessons-from-two-high-co2-worlds

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AQUACULTURE UPDATES BY REGION

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The Pacific Micronesia Association for Sustainable Aquaculture: Aquaculture Business Investment Planning and Development

This article provides an update on two similar projects that have been launched to assist Micronesia countries further develop and sustain aquaculture activities, through an improved aquaculture business and investment planning approach. In particular, the first project is titled “Aquaculture business investment planning and development to increase resilience and improve food security” for members of the Micronesia Association for Sustainable Aquaculture (MASA) Network. The second is titled “In-depth aquaculture risk assessment and business investment planning” for Kiribati.



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MASA group farm visit

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Two main activities have been recently completed under both projects:

- A regional inception workshop for both projects (Koror, Palau 13-14 August, 2018) for MASA countries and Kiribati.
- Palau national aquaculture stakeholder consultations (15-17 August, 2018) included both formal and informal meetings, as well as visits to aquaculture facilities in Palau.

The projects were developed for MASA countries (Republic of Palau, Republic of Nauru, Republic of the Marshall Islands, and the Federated States of Micronesia) and Kiribati. They aim to improve the technical capacity of these countries in increasing and sustaining aquaculture productivity, through an improved aquaculture business and investment planning approach. This will be achieved by developing

national aquaculture business development strategies for each country, which will go towards the development of a regional aquaculture business development strategy at the end of the projects. The regional strategy will then be presented at a regional forum to engage support from potential donors and investors.

The Regional Project Inception Workshop in Koror was led and facilitated by FAO and the Pacific Community (SPC), who is the Service Provider to implement the projects under a Letter of Agreement (LoA). Present at the workshop were National Project Coordinators and National Aquaculture Consultants from each of the five countries involved, together with an International Consultant (Aquaculture Business Development Specialist). Amongst key project players, the workshop discussed project activities and agreed to a schedule of upcoming activities to be implemented in the coming months. The workshop agreed to implement national aquaculture stakeholder consultations and collect relevant data and information required to develop the national strategies for each country, before the end of 2018. The Pacific Community will be leading these consultations with the international consultant. Dates for when countries will hold their respective national aquaculture stakeholder consultations have been identified and highlighted below:

- Palau: during this mission.
- Nauru: 22-25 October, 2018.
- Marshall Islands: 29-31 October, 2018.
- Federated States of Micronesia: 6-8 November, 2018.
- Kiribati: 26-29 November, 2018.

The Palau National Aquaculture Stakeholder Consultations

invited various key aquaculture stakeholders in Palau to gather their feedback that will help develop the Palau National Aquaculture Business Development Strategy. Key stakeholders included relevant government agencies, organizations and aquaculture operators or farmers. Site visits were also made to several farms culturing milkfish (*Chanos chanos*), rabbitfish (*Siganus spp.*), mudcrab (*Scylla serrata*) and ornamental species such as giant clams, reef fish and live corals.

It was gathered from these consultations that stakeholders envisioned a national aquaculture strategy that will help further develop and sustain aquaculture in Palau and its contribution to food security, economic and livelihood development, as well as environmental sustainability. Farming experiences, both challenges and opportunities, were shared by stakeholders to gather an update of priority issues currently faced by aquaculture operators, as well as government agencies with relevant mandates that affect local aquaculture operations. Some of the key challenges currently faced in Palau for aquaculture included the lack of a legal framework and streamlined processes required to establish and manage an aquaculture farm, limited government resources to support farmers, high operation costs, market issues as well as poaching.

With Micronesian countries present in Koror, a Special Meeting of the MASA Network

and Kiribati was also held on 14th August, 2018, where FAO and SPC were also invited to attend. Members broadly discussed progress of their work and expressed a positive drive on the need to finalize certain outstanding matters required to help move the Network forward.

As the lead implementing agency, SPC will continue to lead implementation of the project activities through to August 2019, when the projects end. Immediate next steps agreed to in Palau are:

- Conduct aquaculture stakeholder consultations for the remaining four countries before the end of 2018. Countries have to immediately start collecting relevant data and information before the consultations to help SPC and the International Consultant prepare for their next country visits.
- Based on consultations and information collected from Palau, a National Aquaculture Business Development Strategy for Palau will be developed, to be later shared with relevant stakeholders in-country for their review before it is finalized.

Further updates will be provided on the progress of the projects and MASA Network in the coming FAN editions.



Culture of *Acropora* corals in the Solomon islands

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The Seventh Regional Consultation Forum Meeting of the Asia-Pacific Fishery Commission

The Seventh Regional Consultative Forum Meeting (RCFM) of the Asia-Pacific Fishery Commission (APFIC) was held from 7 to 9 May 2018 in Cebu, the Philippines. The meeting was attended by 79 delegates representing 16 APFIC member governments and nine regional and international organizations and civil society organizations.

On behalf of Ms Kundhavi Kadiresan, FAO Assistant Director General and Regional Representative of Asia and the Pacific, Mr Jose Luis Fernandez, FAO Representative in the Philippines welcomed the meeting participants. He highlighted the importance of "Sustainable Development for Resilient Blue Growth of Fisheries and Aquaculture" in contributing to achievement of SDGs. Mr Eduardo Gongona, Undersecretary for Fisheries, Department of Agriculture, Bureau of Fisheries and Aquatic Resources, the Philippines formally opened the meeting. He informed the meeting the recent progress made by the Philippines in improving fisheries management and support the sustainable development of aquaculture in the country and anticipate the outcome of the meeting would benefit contribute to the resilience of fisheries and sustainable growth of blue economy in the region.

Representing the FAO Fisheries and Aquaculture Department, Ms Vera Agostini, Deputy Director, FAO Fisheries and Aquaculture Division delivered a keynote presentation on "Promoting resilient Blue Growth in marine and inland capture fisheries". She provided a global perspective on the growing food demand due to population growth and the worrisome trends in undernourished, and introduced the blue growth approach and how it can contribute to meeting increasing demand for food fish and overall socioeconomic development in the global and Asia-Pacific context. The Secretariat presented the regional overview on status and trend of fisheries and aquaculture in Asia-Pacific region, which covered recent trend of capture fisheries and aquaculture production by species group and sub-region and overall trade perspective. The regional overview also included analyses on priority issues related to resilience of fisheries and aquaculture sector in the region.



Participants at the 7th Regional Consultative Forum Meeting

The RCFM meeting held four fisheries and aquaculture parallel sessions, which covered a number of thematic issues pertaining to sustainable development aquaculture sector, which included:

- Strengthen aquaculture planning and management through adoption of relevant strategies.
- Strengthen aquaculture regulation, EAA and zonal development.
- Promote climate resilient/smart aquaculture and innovative aquaculture systems/practices for more sustainable and efficient production.
- Aquaculture insurance for resilience of small farm holders.
- Risk of Antimicrobial resistance in aquaculture and required coping strategy and actions.
- Promote responsible production and use of feed and ingredients for sustainable aquaculture growth.
- Enhance woman's role and benefit sharing along the aquaculture value chain.

Representatives from the countries and regional, international and civil society organizations made over 30 presentations sharing the perspectives, successes and lessons of individual country in addressing the issues. Four working group sessions were convened to draw recommendations on strategy and actions for effectively addressing the issues at country and regional levels. The full report on the RCFM is being finalized and will be made available soon in the FAO Web site.



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The Development of Small-Scale Trout Farming in Kyrgyzstan

Since 2009, and in collaboration with the Food and Agriculture Organisation of the United Nations, the Ministry for Foreign Affairs, Government of Finland, has been supporting the innovation of the aquaculture and fisheries sectors in the Kyrgyz Republic through a Government Cooperation Programme (GCP) - "Towards Sustainable Aquaculture and Fisheries Development in the Kyrgyz Republic". During the Soviet era, aquaculture production peaked at approximately 1 050 tonnes per annum, with production primarily focusing on extensive carp production (common, grass and silver carps), and the production of sevan trout (*Salmo ischchan*) and white fish (*Coregonus* spp.) to support culture-based fisheries in the country's major lake and reservoir systems. Following the collapse of the former Soviet Union in 1991, aquaculture production in the country declined rapidly, and by the start of the project support, it was less than 300 tonnes per annum. In order to reinvigorate aquaculture production, the project has been supporting the development of aquaculture associations and providing technical and material support to emergent farmers.



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Water inlet supply and hatchery building

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The "Eldos Plus" Aquaculture Association at Ton, Issyk-Kul province comprises 28 farmers. To date, the project has assisted the farmers to build a small trout hatchery with a capacity to rear 120 000 fry per production cycle, and a small feed mill with a maximum production capacity of 600 kg aquafeeds per hour. Currently the Association members have approximately 45 000 rainbow trout (*Oncorhynchus mykiss*) which are being grown-out under pond culture conditions. The majority of the grow-out production is based at the hatchery site with some farmers electing to grow fish in their private farms.

The farmers have been provided with technical training to operate the hatchery facilities and formulate and manufacture their own feeds based on locally available feed ingredients. In this regard, they have developed a grow-out feed that costs approximately half that of the imported equivalents. With feed costs typically accounting for

approximately 60 percent of production costs in aquaculture, the development of cost-effective, good quality locally manufactured feeds has proven instrumental in reducing production costs and maximizing economic returns to the farmers. To reduce feed costs further, the farmers have started to plant barley, wheat and soya crops, thereby producing some of the main feed ingredients used in their feeds, and reducing feed production costs further. In 2017, the Association harvested 47.3 tonnes of feed ingredients that will subsequently be used to manufacture their feeds. More recently the farmers have started to diversify their feed production, and are now using the feed mill to manufacture terrestrial animal feeds (principally cattle and poultry feeds) based on a business model that has been developed in collaboration with the project.

To date, the material support provided by the project has been approximately USD 40 000. In light of the successful transfer of technology and proof of



Newly hatched rainbow trout fry

concept, the Association members have now invested a further USD 15 000 of their own money into their production systems. This money has been used to construct four nurseries and five grow-out ponds at the hatchery site, and fund the importation of a further 100 000 trout eggs from Denmark. The Association employs one of the Association members to work at the hatchery and fingerling production site on a full-time basis. Future plans include the development of fish processing capacity, and the development of the site as a recreational fishing/tourist destination.

In addition to the technical training, the farmers have been provided with business planning and marketing training to ensure that they can operate the Association on a sustainable commercial basis and are equipped with the skills to market their products effectively. To promote commercial sustainability within the Association, the project supported the farmers in the development of a credible business plan. This is now being used to apply for a commercial loan of USD 5 000 from one of the country's agricultural banks,

with the funds being used to support future developments at the site.

There are a number of key factors that have been instrumental in the success of the Association. At the outset, and in the interests of promoting the cohesion within the Association, it has been critically important to

assist the community members to develop an equitable and fair Association charter in which the rights and responsibilities of the membership are clearly enunciated, and the sharing of the proceeds are clearly defined and agreed upon. Garnering the support of local government agencies and the provision of the land for the construction of the hatchery facilities on state land has also proved important.

Providing on-going mentorship is important. Aquaculture is a complex farming activity and inculcating novel culture technologies to farmers that have no previous experience in fish culture takes time. The members often view the project's technical interventions as unduly complex, and only when their own systems/interventions fail, do they agree to adopt the proposed technologies. Therefore, persistent capacity building through various mechanisms (including farmer field schools) is vital to the sustainable development of small-scale trout farming or other aquaculture operations in Kyrgyzstan.



SEE ALSO

Shipton, T.A., Hasan M.R. 2016 - *Installation of Feed Mills and Hatcheries and Initiation of Carp Broodstock Programme in Kyrgyz Republic*. FAO Aquaculture Newsletter 55. September 2016. pp 22-23. www.fao.org/3/a-c0382e.pdf

FAO Cultured Aquatic Species Information Programme. Oncorhynchus mykiss. Text by Cowx, I.G., 2005. www.fao.org/fishery/culturedspecies/Oncorhynchus_mykiss



Feeding rainbow trout in the grow-out system

The 35th Session of Asia-Pacific Fishery Commission (APFIC)

The 35th session was held from 11 to 13 May 2018 in Cebu, the Philippines. The session was attended by delegates from 14 Member countries of the Commission, observers from two non-APFIC FAO Member countries, nine partner Organizations and the APFIC Secretariat. The meeting opened with welcome remarks delivered by the designated APFIC Chair, Wilfredo M. Cruz, Regional Director, Regional Office No. 3 of Bureau of Fisheries and Aquatic Resources (BFAR), the Philippines on behalf of Mr Eduardo B. Gongona, Undersecretary for the Department of Agriculture and National Director of BFAR, the Philippines and opening remarks delivered by the Acting Secretary of APFIC on behalf of Kundhavi Kadiresan, FAO Assistant Director-General and Regional Representative for Asia and the Pacific.

The Secretariat of APFIC reported to the Commission on the activities implemented since the thirty-fourth Session, which covered regular programme work and project activities at regional and country levels. The Commission commended the Secretariat on the wide range of activities that had been undertaken in response to the recommendations of the thirty fourth Session, and expressed its appreciation to FAO for the support to Commission's work and the member countries. The Commission noted inland fisheries, safety at sea, decent work, South-South cooperation, ecosystem approaches to aquaculture and fishing capacity management



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Participants at the 7th Regional Consultative Forum Meeting

should be the areas to be strengthened in the next biennium.

The Secretariat introduced the report on the 76th Meeting of APFIC Executive Committee (EXCO), which was convened in Manila, the Philippines from 11 to 23 February 2017 and the major outcomes from the seventy RCFM of APFIC held from 7 to 9 May 2018 in Cebu, the Philippines. The Commission reviewed and endorsed the report on the 76th meeting of APFIC EXCO and the recommendations from the 7th APFIC RCFM with comments to major thematic issues that were covered by the RCFM.

The Secretariat introduced the Regional Review of Aquaculture in the Asia-Pacific Region 2016 prepared by the Secretariat. The Commission complimented the important workshop carried out by the Secretariat and suggested future improvement in the methodology and content of the review.

The Secretariat introduced major APFIC/FAO regional event and initiatives to the Commission, which included:

- Implementation of FAO's Regional Initiative on Blue Growth in the Asia-Pacific Region.
- Regional consultation on Building Climate Resilient Fisheries and Aquaculture in the Asia-Pacific Region.
- Regional consultation on Promoting Responsible Production and Use

of Feed and Feed Ingredients for Sustainable Growth of Aquaculture in Asia-Pacific.

- Support for the implementation of the IPOA-IUU in Member countries.
- Resource mobilization to support sustainable fisheries and aquaculture in the APFIC region.

The Commission commended the Secretariat and FAO for organizing the important regional events and implementing the major regional initiative on blue growth to support the sustainable and resilient fisheries and aquaculture sector in the region. The Commission recommended the Secretariat and FAO on how to effectively implement the recommendations from the regional consultations and the regional initiative on blue growth.

The Secretariat presented the draft APFIC 2018-2023 strategic plan prepared in response to the request by the 34th APFIC Session and APFIC work plan and budget for 2018 to 2019. The Commission reviewed and commented on the new APFIC strategy and endorsed the strategy with suggested modifications. The Commission endorsed the APFIC work plan and budget for 2018 to 2019 prepared by the Secretariat.

The Commission elected Thailand as the Chair country and China as the Vice Chair country of the Asia-Pacific Fishery Commission for the biennium from 13 May 2018 up to the 36th APFIC Session in 2020.

Technical Training on Turbot Farming and Restocking in Trabzon, Turkey

The General Fisheries Commission for the Mediterranean (GFCM) of the Food and Agriculture Organization of the United Nations (FAO) organized on 14-23 May 2018 a training on turbot farming and restocking, in collaboration with the Central Fisheries Research Institute (CFRI) in Trabzon, Turkey. This activity is the first of a series of demonstrative trainings planned for the Black Sea region and was attended by aquaculture experts and technicians from Bulgaria, Georgia, Romania, the Russian Federation, Turkey and Ukraine.

The purpose of these training courses is to address the need to foster and enhance processes towards sound aquaculture development, by showcasing best practices in terms of production methods for marine species of economic and environmental interest. These activities are organized within the framework of the Aquaculture Demonstrative Centres that have been recently established by the GFCM in the Black Sea as regional hubs fostering aquaculture activities to ensure the sustainability of the sector. The training course organized in

Trabzon focused on turbot (*Scophthalmus maximus*), an important commercial species for the Black Sea, and was organized in May as it coincides with the breeding season of this species.

The theoretical part of the course was introduced by Mr Ilhan Aydin, Director of the CFRI, and was followed by practical activities carried out in the laboratory of the institute, at the hatchery and at sea, with the help of the local fishers and fish farmers. Among the many aspects tackled, course participants learned how to manage a marine hatchery, turbot larvae and juveniles and were taught on the propagation of the organisms that are essential to feed fish larvae during their early life stage, focusing on the diet to meet their nutritional requirements. Trainees also spent several hours on a boat with researchers, discussing criteria to collect the best possible fish in view of including it in the broodstock as well as techniques and processes to handle these animals for reproduction. In addition, they had the opportunity to be directly involved in restocking activities by tagging juveniles. This was also an opportunity to exchange experiences and views.



Identification of sex in young turbot

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Within the framework of the demonstrative activity, a technical manual was produced in order to disseminate the training experience. After this fruitful training experience, other trainings will take place in the Black Sea region. The Aquaculture Demonstrative Centre in Constanta, Romania, hosted by the National Institute for Marine Research and Development (NIMRD) "Grigore Antipa" will hold a training on shellfish culture in September 2018 and the CFRI in Trabzon will host another demonstrative training activity in December 2018, focusing this time on the farming of Black Sea trout (*Salmo trutta labrax*) in recirculation aquaculture systems (RAS) and in sea cages. Other aquaculture experts at different levels from Mediterranean and Black Sea riparian countries have already expressed their interest for such trainings.



SEE ALSO

GFCM website: www.fao.org/gfcm



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Release of tagged turbot fingerlings

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Regional Workshop on Market Access and Fish Trade for Central and Eastern Europe

The Fisheries and Aquaculture Department of FAO, jointly with the Regional Office for Europe and Central Asia (REU) and EUROFISH International Organization, held a workshop for countries in Central and Eastern Europe. The goal of the workshop was to build capacity in post-harvest topics of special interest to countries in transition but relatively advanced in terms of processing sectors and exports to the developed markets in Europe. Participants included government officials and private sector stakeholders. The workshop was held from 19-21 June 2018 and hosted by the Ministry of Agriculture of the Republic of Serbia in Belgrade. There were 56 participants from 10 countries, namely: Albania, Belarus, Bosnia and Herzegovina, Georgia, Montenegro, Republic of Moldova, The Former Yugoslav Republic of Macedonia, Serbia, Turkey and Ukraine.

Capture fisheries and freshwater aquaculture play an important role in the economies of Central and Eastern European countries. Fish processing for export represents a significant source of hard currency earnings and employment.



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Workshop participants, Belgrade, Serbia

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Internationally, the regulatory framework of the World Trade Organization (WTO), with its various agreements (e.g. Sanitary and Phytosanitary Agreement, Agreement on Technical Barriers to Trade, Anti-Dumping Agreement, Subsidies and Countervailing Measures, Dispute Settlement), has an important role in governing international fish trade to the main importing markets of the European Union, North America and Japan. This includes fish exports originating from non-EU Members in Eastern Europe, the Balkans and Caucasus.

In addition to the WTO agreements, fish processors and traders face increasingly complex value chains that include import regulations and international standards. For example, the FAO/WHO Codex Alimentarius is the guiding international standard for food safety and quality assurance of fish products as well as improved access to international markets. The FAO Port State Measures Agreement entered into force in June 2016

and for the signatory countries, including EU Members, this is a binding international instrument that blocks international trade of fish and seafood products that are not properly documented as legal catch. Voluntary seafood certification schemes have become routine tools for retailers and customers in Europe and eco-labelled products are making gains in international markets, currently at 14 percent of global production. These issues are complex and often overlapping, making it difficult for developing countries and economies-in-transition to adapt their production, processing and export sectors to the changing international market landscape.

There continues to be a need and demand for local and regional capacity building on post-harvest issues pertaining to international and intra-regional trade of fish and seafood products. This is especially urgent for countries in Central and Eastern Europe that are in the process of joining the European Union. In light of these expressed needs, expert speakers

from FAO, EUROFISH, WTO, United Nations Conference on Trade and Development (UNCTAD), European Commission (DG MARE), and the Norwegian Ministry of Trade, Industry and Fisheries presented a broad range of topics for discussion. Among these topics were: climate change and implications for fish trade; fisheries and the WTO; the EU Common Fisheries Policy; FAO FISHSTAT, global trends and outlook model projections; fish trade overview from Central and Eastern Europe; food safety and quality assurance requirements for fish products; certification and traceability to combat IUU fishing; market access and seafood trade from a Norwegian perspective; consumer demand and perceptions for freshwater aquaculture products; building green and blue national strategies for fisheries; fish value chain gap analysis; and storage and transport requirements from farm to market.

Each of the country delegations gave a presentation on its fisheries sector, along with a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis. FAO prepared a regional SWOT analysis from the country responses. During an interactive group discussion, the participants validated the regional SWOT analysis and provided recommendations related to the workshop topic, namely on ways

to improve market access, fish trade and sustainable fisheries.

The recommendations for Governments and aquaculture stakeholders from the regional workshop are:

- Improve domestic food safety standards to access export markets.
- Countries should reform fisheries policies, legislation, and adopt National Plans of Action.
- Countries from the region should elaborate and approve national strategies for aquaculture development.
- Create wharves and first sale spots for fishers.
- Non-EU countries should exchange experiences and good practices with European countries.
- Provide investment funds for:
 - Vessel repair and maintenance of fisheries infrastructure.
 - Replacement or refurbishment of old fishing vessels.
 - Establishment of wholesale fish markets.
 - Support to fish farmers and SME processors.
- Support establishment of producer organizations for fish farmers and small-scale fishers.
- Support a promotional campaign for fish consumption.
- Improve standard methodologies for statistical data collection for fisheries.
- Improve scientific cooperation among countries within

the region (EU and non-EU members).

- Improve cooperation with regional fisheries bodies and intergovernmental organizations.
- Counteract IUU fishing through better border controls.
- Develop catch documentation schemes to prevent IUU fish entering markets.
- Improve research infrastructure for marine sciences.
- Raise capacity of government institutions in fisheries management.
- Develop intergovernmental plans for shared water bodies and aquatic resources.
- Create marketing channels between fish producers and eco-tourism.
- Improve utilization and development of diversified products and by products from aquaculture.
- Reduce waste and discards from fisheries to meet international standards.

Based on the feedback from the participants, the workshop was rated as a very important and useful training event. On the last day, the Serbian Ministry of Agriculture, Forestry and Water Management organized a field visit to a fish processing company in Čačak. The owner of the company (Principal Duo) gave a tour of the facilities and a sample of the products were served for lunch.



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Handling farmed common carps (*Cyprinus carpio*) produced in Belarus

EU funded project: Ecosystem Approach to Making Space for Aquaculture

Around the world a lack of availability of aquaculture zones and sites with favourable characteristics constrains the expansion of the sector. There is a need for increased space, with locations selected in an organized manner and managed effectively.

Aquaculture often struggles for space due to the crowded nature of human activities especially in many marine coastal areas, and because of limited attention to spatial planning. In the Mediterranean and Black Sea area as in other regions, spatial planning for aquaculture needs to be expanded by using the ecosystem approach to aquaculture as part of an overall aquaculture governance structure. Only a few countries such as Norway, management areas have been created in accordance with agreed strategies, management practices and codes of conduct to manage production in order to reduce and manage risks posed by disease and parasites, including cumulative environmental impacts and social conflict.

The Ecosystem Approach to Making Space for Aquaculture (AquaSpace) was a three-year



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Figure 1 – View of a salmon cage in a virtual reality environment
(Video available at: www.youtube.com/watch?v=ho6A65PuUDM)

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(2015–2018) project funded by the European Union's Horizon 2020 Framework Programme for Research and Innovation. It was led by the Scottish Association for Marine Science with an allocated budget of €3 million. The project attracted 22 partners and carried out 15 case studies in Europe, China, North America, Australia and New Zealand. One case study involved the farming of freshwater fish in Hungary, the remainder dealt with the farming of marine finfish and shellfish.

The purpose of the project was to critically examine how to make space for sustainable aquaculture, with the goal of improving food security and employment opportunities through economic growth. This was done by identifying and attempting to overcome some of the key constraints limiting the industry's development using an ecosystem approach to promote a sustainable increase in the production of aquaculture in the European Union (EU).

The key outputs of the project fall into four categories, namely policy and management support,

tools for aquaculture development, training and communication.

Policy and management support

- A web-based questionnaire survey solicited the perceptions of government institutions, the aquaculture industry and research institutions about current approaches to spatial planning for aquaculture in marine and freshwater environments in Europe and non-EU countries in the Mediterranean and Black Sea region.
- A review analysis, based on information from the web-based questionnaire survey generated recommendations for policy-making.
- A review of the case studies at 17 sites synthesized stakeholder views on the policy and legal, market, social and environmental challenges facing the aquaculture sector at a variety of local, national and regional scales, and in freshwaters as well as the sea.

Tools for aquaculture development

- A "toolbox" was created to provide information

and guidance on spatial planning covering a wide range of tools and methods that were developed and/or enhanced over the course of the AquaSpace project are available via the project website. These included legal instruments (laws, regulations, guidelines); processes (such as stakeholder engagement); computer model applications (e.g. geographic information systems, or computer models to assess potential environmental impacts of aquaculture); and software or sets of instructions to aid decision-making on spatial planning for aquaculture.

A simulator of an aquaculture development was developed by Mr Anders Bøe, Norwegian University of Science and Technology for AquaSpace to explore options for uses of Scotland's coastal waters. It enables the user to inspect the fish cages and moorings, and swim amongst the fish (Figure 1).

Training

- Training materials such as lectures texts, slides and other relevant educational material for the AquaSpace Masters Module on "Planning and Managing the use of Space for Aquaculture" were prepared and are available in the AquaSpace Web site.
- A three-day "Continuing Professional Development Course" on planning and management of space for aquaculture, targeted at aquaculture professionals, regulators, researchers and representatives from other maritime industries and interest groups.

Communication

- Ten articles were published in a range of journals and at least 10 more are in preparation.
- Annual newsletters were produced.
- Additional funds are being identified for the purpose of

publishing the experiences and outcomes of the 16 case studies in book format.

- A number of videos to raise awareness about spatial planning for aquaculture were produced (for example, see: <https://youtu.be/qjEODBnpCms>).

The intended users of the outputs of AquaSpace are planners, industry, regulators, technical personnel and all other actors interested in the development of aquaculture in terms of its use of space, including environmental NGOs and the general public.

AquaSpace project produced synthesized information on constraints on aquaculture growth, which appear to lie as much in the domain of society and governance as in environmental limitations. The project developed tools that can support spatial planning, guide investment in aquaculture, aid disease management, and help understand and ameliorate some of the social constraints. The tools will need further investment for wider uptake but they are already readily available for many users.

The overall impact of the project will be to enable the aquaculture sector to grow sustainably and to effectively negotiate for space by applying spatial planning tools.

The outputs of the AquaSpace project have the potential to contribute to the increased growth of coordinated aquaculture planning, in line with the European Commission's Strategic Guidelines that identified coordinated spatial planning as a priority. The project outputs also contribute to policy objectives through the simplification of administrative procedures, enhancing competitiveness and promoting a level playing field.

Innovations generated within AquaSpace have a global reach and will help improve the environmental and social sustainability of aquaculture production, much of which is imported to the EU. Thus, AquaSpace will not only provide innovations that allow the growth of the EU industry, it will also help to improve the social and environmental sustainability of imported aquaculture products.

Within the EU, marine spatial planning needs to be more effectively implemented and its multi-sector approach applied to nearshore waters where aquaculture is presently subject to complicated and slow Town and Country Planning regimes. Integrated coastal zone management should be considered as an alternative solution.



SEE ALSO

Websites of AquaSpace project: www.aquaspace-h2020.eu

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Mass Media Communication and its Impact on Market Behaviour in Mediterranean Aquaculture

As in any other economic activity, public perception of aquaculture is a key topic affecting the development of the industry and its economic and social sustainability. Information released in the mass media has a potential effect on its audience which may positively or negatively affect the evolution of the industry and its future growth. Study of the relationship between mass media and public opinion about aquaculture, its social acceptability and impact on market performance is included in several different tasks under the MedAid (Mediterranean Aquaculture Integrated Development) project (H2020; GA no. 727315), an European Commission funded project aimed to improve the efficiency and performance of the Mediterranean fish farming industry. FAO contributes as a partner of the MedAid consortium through its Products, Trade and Marketing Branch that co-leads Task 6.3 (WP6: Economics), and through the General Fisheries Commission for the Mediterranean (GFCM) as



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Fish shop selling aquaculture products in Tirana, Albania.

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co-leader of WP7 (Governance and Social Acceptability).

In order to set a framework and establish methodologies for analysing information released by the media in the Mediterranean countries and their impact on the attitudes of consumers, retailers and policymakers, a group of experts participated in a workshop at the FAO headquarters in Rome in May 2018. The workshop provided a forum for discussion and review the methodologies analyzed findings and identified further steps in the analysis included in the MedAid tasks.

A total of 26 participants, including MedAid and PerformFish (Integrating Innovative Approaches for Competitive and Sustainable Performance across the Mediterranean Aquaculture

Value Chain) H2020 projects FAO staff, and representatives of National Governments, producers' associations and specialized journalists of the three countries targeted in the fieldwork case studies (Spain, Italy and Greece), contributed to the presentations and discussions. The morning sessions focused on describing the most up to date figures and trends in aquaculture production and trade in Mediterranean aquaculture, introduced the MedAid project including working packages (WP) 6 and 7. Special attention was given to discussion on the methodology to be used in a case study covering the impact on market behaviour of information released by traditional newspapers. An index based on different attributes of the messages sent in the news will be applied to the analysis of the image of aquaculture in the

media in Spain, Italy and Greece over the last five years. This index will be included in a more complex model to describe the evolution of the seafood market in terms of quantities and prices.

Separate discussions were held in the afternoon, splitting and allocating the participants based on their prioritisation on media or on governance. A final concluding session summarized and presented the main findings of the workshop.

Among the topics discussed, participants highlighted the poor knowledge about aquaculture in the mass media and a higher likelihood of media publishing negative rather than positive information. Frequently the information provided in the media is technical and difficult to understand by a non-skilled audience. On the opposite side, it was noted that the aquaculture industry lacks of a sustained and coordinated communication strategy. Communication campaigns on aquaculture are rarely undertaken without public funding. At the individual company level, mass communication is almost non-



Fish processing factory in Bizert, Tunisia

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existent and generally limited to reactive responses to alarms and negative news. It was agreed that regular sectoral meetings with the media to clarify concepts and provide updates about the progress in the industry, highlighting good practices, and social responsible actions may contribute to improving the perception of the industry by the media and by the community. It is also important to interact with all kinds of media and consider different targets. Traditional media cover a large and wide

audience but is uni-directional. Interactive communication in social media is gaining attention from consumers as a way for acquiring information about companies and products, and thus increasingly influencing purchase decisions. Diversification of targets, selecting messages and tools for different audiences, is recommended since consumers may not be interested in technical information or may misunderstand the implications. For these and other reasons consumers may not rely greatly on information provided in the media but would look for alternative sources of information. One of the most common sources of information is the retail salesperson. Retailers have a strong influence on consumers' decision making but may not be proactive toward aquaculture species if they lack adequate information. As in the case of the media, provision of information to retailers and interaction with the salesperson who is the contact with consumers is expected to help contribute to improvement of consumers perceptions about aquaculture in general and of certain species in particular.



Fish shop selling aquaculture products in Tunis, Tunisia

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Rice-fish Farming in Iran: History and Development

Introduction to rice production in Iran

When thinking about the geography of the Islamic Republic of Iran, many people would picture high mountains, arid deserts and cool nights. However, Iran actually enjoys a diverse climate, ranging from arid and semi-arid, to subtropical along the Caspian coast and the northern forests. On the northern edge of the country (the Caspian coastal plain), geographic features like the Alborz Mountains cause temperatures to rarely fall below freezing, with the area remaining humid year-round. Even so, many areas are dry, receiving only 250 mm of rainfall a year. This climate necessitates certain agricultural practices to differ between areas, reflecting a local saying that “the temperature is the director of all things”.

Iran is the 26th largest producer of rice based on 2016 estimates, and its production has steadily increased over the last 40 years, reaching about 2.4 million tonnes and 550 thousand hectares of rice fields throughout the country, predominantly located in the provinces of Gilan and Mazandaran. This growth was



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accompanied by an increase in yield, from 2.8 tonnes/hectare in 1965 to over 4.2 tonnes/hectare in 2016 as well as a small expansion of land under cultivation.¹ The improved yields were caused by multiple factors, including technological advancements, high-yielding varieties, integrated pest management, better irrigation infrastructure and management, as well as integrated farming systems such as rice-fish farming.

Rice-fish farming is currently estimated by experts to be practiced in 10 percent of all rice fields in Iran, for a total area between 50 thousand and 72 thousand hectares.

History of rice-fish farming in Iran

Mr Tahmores Ranjbar Koti Lateh Savadakouh is widely recognized as the champion and scientific lead expert of rice-fish culture in Iran, beginning with his research on pest management of rice in the 1980s. Mr Tahmores Ranjbar has also played a major role in the development of aquaculture within his country, including introduction of novel irrigation methods, new species and saline aquaculture. During this time, Mr Ranjbar visited rice fields in China and was exposed to traditional rice fish farming methods, which was facilitated by FAO in an early example of South-South Cooperation.

In his memoirs, Mr Ranjbar remembers this moment and gives thanks to the experience, which, “has given [me] this great historic



Mr Tahmores Ranjbar Koti Lateh Savadakouh

responsibility for the transfer of technology, the cultural heritage of rice-fish culture from the ancient nation and the forerunner of China as a souvenir of science to my beloved homeland.”

This trip provided an opportunity to better understand the techniques associated with rice-fish farming, and then to transfer them to Iran. This then set the foundation for the practical development of rice-fish farming, as well as extensive research and experimental studies in the field. Since this original introduction much research has been done, resulting in remarkable findings and innovations for the rice and aquaculture sectors of the country. The expansion of rice-fish farming began with participatory research with farmers in their field, which were implemented through applied extension development projects, initially reaching 100 hectares in the provinces of Mazandaran and Gilan.

¹ www.fao.org/faostat/en/#data/QC

Examples of practices

Since its establishment in the country, rice-fish farming advanced while adapting to the local conditions. Some of the specific practices developed by Mr Ranjbar and his colleagues include:

- The development of rotational rice-fish farming systems taking advantage of the seasonal opportunity for rainbow trout (*Oncorhynchus mykiss*) breeding in the paddy fields during the winter when rice cannot be grown. This allows for more efficient land-use, conservation of resources, integrated pest management (IPM) and adaptation of the rice-fish system to a continental climate, such as that of the provinces of Mazandaran and Gilan, in north Iran. The rainbow trout is a highly valued introduced species for Iran, for instance the country is one of the major producing countries of the species and has an expected production increase.
- Another practice is the “spring culture”, which uses the rice paddies to propagate Southern Caspian kutum (*Rutilus frisii kutum*). The stocks of this native species are overfished in the wild, and the rice paddies are used to grow fry and fingerlings after artificial spawning, the larvae are introduced about two months before the rice transplanting and the fingerlings can then be released in the Caspian Sea to support stock enhancement programmes.

Relevance

As experience from Iran suggests and evidence from 18 papers covering five countries has shown that growing rice in rice-fish systems does generally result in



Mr Ranjbar, in the left, collecting rice yield information with the help of the farmer Mr A. Abbasi (Village of Dang –e– Sarak, Mazandaran). Typical yields of fish are between 1 and 3.5 tonnes per hectare

higher yields than growing rice without fish. Rice fields with stocked fish have less weeds competing with the rice for soil nutrients, fewer stemborers and pests and a reduced occurrence of whiteheads, all contributing to the production of healthier rice plants with more and bigger grains². This is also supported by research carried out by Mr Ranjbar in 2001, showing a 17 percent increase in the total number of seeds in rice-fish farms as compared to rice farms without fishes, with the number of seeds being an

indicator of the health of rice plants. His research also shows a reduction of rice stemborer (*Chilo suppressalis*) by six times in rice-fish fields, with the fish also acting as a natural fertilizer. As a result, rice-fish was demonstrated to be a cost-effective farming system resulting in the prevention of diseases mitigating negative environmental effects and boosting production for food and livelihood.

Mr Ranjbar continues to highlight the importance of rice-fish farming



Applied extension stage of a 6 hectare farm of rice and fish (Larim village, Mazandaran Province). Release of fry (10 000 per hectare) by Mr Ranjbar and his colleague (Ranjbar Tahmores, 1988)

2 www.fao.org/3/a-a0823e.pdf

and has dedicated his career to foster the development of rice-fish farming and aquaculture in his country. His strong interest derives from his faith that *“through the process of applied research it is easy to solve mysteries, as wishes develop into ideas for solving problems and can also grow into phenomena and inventions”*.

One of the problems Mr Ranjbar seeks to address is related to earth's most precious resource: water. This is a high-priority problem today, posing a threat to the development of rice-fish farming in Iran and of food production and human health globally. Conservation and sustainable use of natural resources is critical to the food security and nutrition of our global population, especially when considering crops such as rice, which is a staple food for about half the world population.

With global rice production estimates at just over 500 million tonnes (in milled terms) in 2017³ and FAO-IRRI outlooks for 2030 indicating a global demand

ranging between 503-544 million metric tonnes, the rice sector needs to continue to grow sustainably.

Rice-fish systems⁴ are a great opportunity for the sustainable intensification of rice production as they raise system level productivity, thereby increasing not only yield but also total factor productivity while minimizing the depletion of water, soil erosion, downstream silting, salinity build-up, erosion of biodiversity, resurgence of rice pests and pollution caused by agrochemicals.⁵

Conclusion

The diversification of production systems favours ecosystem services, boosting efficiency in the use of natural resources (soil, air, sun, and water) through the synergy of components, natural recycling of elements and leading to greater resilience of agro-ecosystems. Rice-fish farming and related holistic approaches to integrated agriculture with aquaculture combine ecological concepts to

the design and management of agricultural production and food systems. Thereby, they will be necessary for countries to promote sustainable agriculture and meet their development goals. FAO continues its support, and champions like Mr Ranjbar leading the way through innovative practices and transforming agriculture will remain essential advocates driving us forward towards zero hunger.

Note: This article has been prepared by Ms Chiara Sirani (FAO Intern) at the request of the author as a condensed and edited version of the original manuscript on rice-fish farming in Islamic Republic of Iran by Mr Tahmores Ranjbar Koti Lateh Savadakouh (translated from Persian to English by Mr Reza Javan). Comments on an earlier version by Mr Pourkazemi (Iranian Fisheries Science Research Institute), Mr Halwart (FAO) and Ms Elizabeth Graham (FAO) are gratefully acknowledged.

3 www.fao.org/worldfoodsituation/csdb/en/

4 Rice-fish systems encompass the wide range of aquatic species (including finfish, crustaceans, molluscs, reptiles, insects, amphibians and aquatic plants) used for consumption and/or sale and integrated farming systems (concurrent, rotational, side-by-side using the same water resources) being practiced in various intensities of input use from the harvesting of wild fish to the introduction of cultured fish.

5 www.fao.org/3/a-i3643e.pdf



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Rice fish farming in Viet Nam

Eighth Meeting of RECOFI Working Group on Aquaculture

The Regional Commission for Fisheries (RECOFI) is a Regional Fisheries Management Organization established in 2001 with the aim of promoting the development, conservation, rational management and best utilization of living marine resources, as well as improving the sustainable development of aquaculture within its area of application. The Commission has two subsidiary bodies, the Working Group on Fisheries Management and the Working Group on Aquaculture (WGA).

The Eighth meeting of the WGA was held in Kuwait City, State of Kuwait, from 17 to 19 April 2018. Twenty-three participants from six Members of the Commission attended, namely, Bahrain, State of Kuwait, Sultanate of Oman, State of Qatar, Saudi Arabia and United Arab Emirates. The Regional Organization for the Protection of the Marine Environment (ROPME) was also present at the meeting as an invited regional organization. The meeting was organized by the RECOFI Secretariat, in close cooperation with FAO Regional Office for Near East and North Africa, the FAO Aquaculture Branch, and the Statistics and Information Branch. The meeting was structured around the following main sessions; (i) reporting by the Secretariat on the progress of work carried out during the intersessional period; (ii) review of status and trend in aquaculture development at national and regional levels; (iii) priority setting for activities of the WGA; and (iv) preparation of the work programme for 2018–2020.

During the first day of the meeting, the RECOFI Secretary (H. Fersoy) presented the intersessional activities of the WGA, followed by a summary of the main decisions and recommendations made at the Ninth Session of RECOFI, the Ninth session of Committee on Fisheries Sub-Committee on Aquaculture, and the Thirty-third session of the FAO Regional Conference for the Near East. This was followed by one presentation from each WGA Member country on the status of aquaculture development and a presentation on the Regional Aquaculture Information System (RAIS) by the Representative from the State of Kuwait.

The second day included three presentations by the Secretariat on (i) the “Status of implementation of



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Participants at the Eighth RECOFI Working Group on Aquaculture

RECOFI decisions and recommendations on Minimum Data Reporting on Aquaculture” and “An update on latest FAO aquaculture data registered for RECOFI countries in the latest FAO global aquaculture dataset” (X. Zhou); (ii) “Developing Marine Cage Culture in the Near East” (J. Aguilar-Manjarrez, and (iii) “An Overview on Desert and Arid Land Aquaculture: Opportunities and Impediments” (V. Crespi). This was followed with an agreement for the work programme for 2018-2020.

During the last day of the meeting, in the morning the WGA participants visited the Kuwait Institute for Scientific Research (www.kisr.edu.kw/en) and in the afternoon they adopted the draft report of the meeting.

Among the main priorities identified for the region, the WGA agreed on the importance of:

- Adopting the proposed roadmap for the implementation of RECOFI recommendations on minimum data collection and reporting on aquaculture.
- Improving national data collection and reporting on aquaculture data and information sharing.
- Sharing work experiences on aquaculture spatial planning and defining criteria and indicators to be used for marine fish cage culture site selection.
- Revising and updating the contents of Regional Aquaculture Information System (RAIS).

The WGA decided to include a regional workshop on harmonized RECOFI aquaculture data collection and dissemination in line with Internationally Established Standards in the workplan, with the tentative date in December 2019.

The WGA concluded to organize a technical workshop on “Guidelines on marine fish cage site selection” to be held in Oman in April 2019. The next meeting of the WGA will be held in April 2020 in one of the RECOFI Member countries.



SEE ALSO

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Regional Aquaculture Information System (RAIS) website: www.raisaquaculture.net

Report of the 8th meeting of RECOFI-WGA: www.fao.org/3/CA1351EN/ca1351en.pdf

Assessment of Aquaculture Value Chain in Lebanon

This article describes the results of an FAO project to assess aquaculture value chain in Lebanon. Aquaculture has been practiced for many decades in the country. In 2017, total fishery production from marine capture fisheries and aquaculture were 3 608 and 1 225 tonnes, respectively. The vast majority of aquaculture production is concentrated on rainbow trout (*Oncorhynchus mykiss*), which commonly grown in small to medium scale farms using semi-intensive farming systems. Forty-seven percent of the farms are small (surface area less than 500 m²), 38 percent of the farms are medium sized (501-1 500 m²) and 15 percent are large size (over 1 500 m²). The inland fish farms are located mostly in the inner planes of Baalbek and Hermel region and to a lesser extent in Akkar governorate with an additional small number of establishments distributed between Mount Lebanon's Chouf area and Nabatiyeh in the South. There is currently only one onshore mariculture farm in operation in Aabdeh, Akkar in the north of Lebanon that produces whiteleg shrimp (*Penaeus vannamei*).



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Rainbow trout (*Oncorhynchus mykiss*) farming

In 1960, the Anjar Centre for Aquaculture was established by the Ministry of Agriculture (MOA) in Bekaa area to become the first hatchery among the neighbouring countries. Afterwards, MOA resorted to hatching imported certified eyed eggs (from Denmark, South Africa & USA) for distribution. The MOA Hatchery is reported to have been producing 500 000 - 2 000 000 fry/year of rainbow trout and 200 000 fry/year of fario trout (*Salmo trutta fario*). No hatchery facilities exist for other aquaculture species. The shrimp farms import larvae from United States of America and Thailand.

The tilapia farms produce their own fry from parent broodstock imported from South Africa.

A large number of trout farmers feed the fish with only aquafeeds. The price of aquafeed and fishmeal is a very important factor in deciding whether use a manufactured diet or chicken processing wastes. Trout farmers occasionally, despite MOA's ban on use of slaughterhouse wastes, replace the commercial diet with poultry by-products because they cannot always afford to purchase the commercial one. The shrimp farm resorts to using imported feed from Saudi Arabia. Tilapia also use imported aquafeeds.

Local seafood consumption trends vary according to regions. Inhabitants of cities and coastal areas prefer marine fish, whereas inhabitants of Bekaa Valley (inland area) prefer beef and chicken to fish and they mostly consume trout. Medium size trout fish is sold live to restaurants, which have their own concrete holding tanks.

A large quantity of produced trout is channelled through local restaurants at or close to the production farms. Prices of trout remain low as compared to marine fish due to lack of local demand and misperception that freshwater fish is of lower quality. Some farmers sell their products to supermarkets, but most sell them at their farms or restaurants. The marketable size is 250-350 g but larger sizes (0.5-1 kg) are also demanded. After land crop production, aquaculture is the second main economic activity of the Hermel, Yammouneh, and Anjar areas and constitutes an income generating activity linked especially with restaurants and tourism in the areas. In Lebanon, the market is not selective for freshwater fish and fishery products, so grading and packaging are not much important. Trout is usually sold chilled, whole, or gutted. The farm price is USD 2-3/kg, whilst the retail price is USD 3-5/kg.

Restaurants buy whole fish, and this non-processed and non-gutted format is attractive to the customers and preserves the 'shelf life' of the product. Restaurants usually serve trout at the table at a price of USD 10/kg. Trout cooking and meals are considered a specialty for the Hermel and Anjar communities. Several restaurants, particularly in the Bekaa Valley, have live trout holding raceways, so customers can select the fish which is then

prepared. Around 60 restaurants in Anjar and Hermel areas serve fresh trout on their menus. Anjar is considered a tourist area where visitors from nearby villages, Beirut, and other cities come for trout meals and enjoy the area with its landscape and water sites. Most of the Lebanese prefer marine fish and still do not know about different recipes that could include trout. However, this source of fish is growing and is increasingly becoming popular to the Lebanese consumer. It represents a good potential and an additional food source if higher production can be attained. It should be coupled with marketing strategies and advertising. This is particularly the case compared with the volume of imported meat quantities in general and fish in particular.

Locally farmed fish is generally sold fresh for human consumption. In recent years, there have been some private investments for filleting and smoking of locally produced rainbow trout. The shrimp farm in Aabdeh, Akkar is the only business that freezes its products. Around 67 percent of the first sales occur through indirect sales, while 23 percent through a direct transaction. Nearly 64 percent of indirect sales pass through the auction markets.

Local fish production is marketed to consumers, besides auctions, on port stalls, by licensed and/or unlicensed shops/supermarkets and fish stalls, directly by fishermen, and by street vendors. Smoking and filleting of about 300 tonnes/year of salmon (imported) and trout and freezing of around 20 tonnes of shrimps is practiced. The FAO project highlighted that fish demand in Lebanon has an order of magnitude greater than local

production while export volume is negligible. Value added product is still lacking on the Lebanese market. The study, however, reports existence of certain aquaculture added-value initiatives, including, but not limited to (i) trout flesh pigmentation by adding carotenoids to trout feed (those trout are then fraudulently locally sold and exported as salmon in some areas) and (ii) smoking, and filleting processes.

The apparent per capita fresh, chilled, and frozen fish consumption was 6.03 kg in 2011 and 8.9 kg in 2017 (including local aquaculture products). Lebanon is not authorized to export fish to the European Union. According to the Lebanese customs data, nearly 23 thousand tonnes of fish (including crustaceans and molluscs) were imported in 2017. It is important to note that, for imports, the majority of the fish and fishery products come from aquaculture and demersal fisheries, particularly from Turkey, Thailand, Vietnam, and Egypt. For the imported species, seabream/seabass, tilapia, red mullet, and shrimps were the most important chilled species. Hake, Pangasius catfish, shrimps, and tuna were the most prevalent imported frozen species. According to the findings of the FAO project, key actors in the value chain of imported aquaculture products includes importers, wholesalers, mongers or restaurants and consumers. Lebanese fish exports amounted in 2017 to only 124 tonnes at a value of 1.3 million USD of chilled, frozen, fillets and smoked seafood items. In this year, the main markets for the Lebanese trout products were Saudi Arabia, Qatar, Jordan, and United Arab Emirates.

Processing is limited to filleting, smoking, and slicing of imported chilled/frozen Atlantic and Pacific salmon. The processing facilities are modern and seem to strictly follow international safety and hygiene regulations that allowed them to establish a bridgehead into some neighboring markets. However, there are also efforts by some entrepreneurs to establish a smoking industry for locally produced trout.

A recent FAO market study ("Lebanon marine fisheries and aquaculture consumer behavior survey and restaurant sector study") found that about half of the interviewed public were aware of freshwater species and one fifth of those consume freshwater species. Trout, which represents the majority of local production, has the highest level of awareness. Knowledge

of other freshwater species is limited by comparison. The coastal consumers mostly are not familiar with trout. When probed if the trout species is a marine or freshwater fish, only 33 percent of the interviewees correctly identified trout as a freshwater species. Most of interviewees had the view that, marine fish and fishery products are tastier, healthier, safer and less polluted than freshwater species.

The combination of factors, including low and unstable supply and low product quality makes the commercialization of the product for those value chain actors that require advance planning, such as the big supermarket chains, unappealing. The local product is well perceived by the consumer and they feel it is of the best quality. This strength of the local products can be

leveraged to support increased production levels.

Lebanese aquaculture sector has high potential for growth. However, more specific actions are needed to strengthen the aquaculture value chain in the country, including improvement of supply chain governance and coordination between public and private stakeholders.



SEE ALSO

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www.fao.org/fishery/countrysector/naso_lebanon/en

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Old man peeling shrimps in a fish market

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Introducing Aquaculture Demonstration Farms: Strengthening Capacities of Small-Scale Farmers in Latin America Countries



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Photo 1 – Agri-aquaculture demonstration farm in Paraguay. (Pig stall at the end and vegetables plot at the pond side)

Small-scale aquaculture farmers (SSAF) are a growing producers segment in Latin America. While in 2005 a preliminary survey reported about 34 000 farmers¹, by 2015 there were more than 500 000 of such farmers throughout the region.² In countries such as Paraguay, Bolivia and Colombia SSAF represent 95, 80 and 65 percent of the total national number of aquaculture farmers, respectively.

In a survey carried out in 15 countries of Latin America³, the limitations more frequently

expressed by SSAF, regarding their productive and economic sustainability, included lack of technical knowledge and expertise; lack of working capital, particularly to buy aquafeeds, and limited access to markets. Based on such a survey, the Aquaculture Network of the Americas (RAA, for its acronym in Spanish), adopted capacity building of SSAF as one of its regional strategic programs.

The Government of Brazil, in support of such a program, funded a FAO-executed project entitled “Activation of services and consolidation of the Aquaculture Network of the Americas – RAA” through which, amongst other lines of work, a regional program was created to promote and operate a series of demonstration agri-aquaculture

farms, championed by selected SSAF in Antigua and Barbuda, Colombia, Costa Rica, Guatemala and Paraguay.

The program was based on the following principles: (i) employing the self-sufficient approach to build in situ capacities, thus ensuring sustainability; (ii) involving targeted SSAF in all steps of the process, to ensure project appropriation; (iii) creating demonstration farms to make field schools open to all SSAF in selected territories to ensure the maximum impact, and (iv) bringing resource-limited, government-subsidized farmers, up to a more sustainable, market-oriented level.

Selection of demonstration farm sites was made in direct coordination with national aquaculture authorities.



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A thorough baseline study of pre-selected territories, which included aquaculture production, family cash income and local fish consumption indicators, amongst others, was carried out. Some of the selection criteria for both sites and farmers to be involved in the program included the following: (i) territories with a high concentration of resource-limited SSAF, (ii) farmers with at least 5 years of continuous production, and (iii) farmers regarded as technical and moral leaders by their local peers.

Following decisions made by targeted SSAF, an array of culture systems was finally included in the program. In the insular country of Antigua and Barbuda, an aquaponics (tilapia and lettuce) farm that had already been working for more than five years, was selected and became a training center for potential farmers of Antigua and Barbuda and other island countries of the Caribbean. Integrated agri-aquaculture farms were operated in indigenous territories of Guatemala as well as in five farm sites of Paraguay, and a tilapia cage culture project was supported in a poor rural village of Colombia (Photos 1 and 2). FAO's involvement in this first phase had a duration of approximately 24 months.

In all cases, farm productivity and family cash income increased significantly (between 15 and 395 percent, and between 23 and 600 percent, respectively). Whilst fish consumption in aquaculture farmers families was already above 34 kg/caput/year at the baseline, consumption of fish in the communities where demonstration farms were located, increased between 10 and 25 percent.

Beyond the good technical and economic indicators, some of the

most important impacts of the project, can be summarized as follows:

- The replication factor in most cases was very high. In Paraguay, one agri-aquaculture demonstration farm (pigs+fish+vegetables) created more than 280 new farmers, which in turn enabled the establishment of a SSAF cooperative. Today, the cooperative has a processing plant and a refrigerated truck to transport their produce to local markets.
- In Guatemala, two integrated farms (fish+vegetables+sheep) resulted in 34 new farmers in an indigenous rural community, thus increasing fish protein availability and generating cash income to rural poor families.

- The demonstration farm in northern Colombia, allowed the community to generate sufficient revenue to purchase a plot of land to grow plant crops and to make available a community fund to be used for contingencies.
- In Costa Rica, the families that depend on the tilapia demonstration farm, increased significantly their cash income and developed a tourist site with a small restaurant where they catch and serve fish.

Not all went well in this project of this nature. Two sites were abandoned by the farmers, thus reflecting a bad selection processes. However, valuable lessons for doing better in the future were learned.



Photo 2 – Tilapia culture site in Sucre, Colombia

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SEE ALSO

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2. Flores-Nava, A.; A. Mena; D. Mendoza y A. Fuenzalida. 2016. *Una Mirada al extensionismo acuícola en América Latina*. FAO-RLC. Santiago, Chile. 91 pp.
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FAO Promotes Intensive Trainings on Doing Aquaculture as Business

Under the leadership of the Aquaculture Branch, FAO has been engaging several countries in sub-Saharan Africa on intensive capacity building trainings to facilitate the adoption of business oriented approaches for the development of small and medium-scale aquaculture enterprises. Trainings of 4-5 days have been developed to address a curriculum that combines the basic technical and economic principles of developing good aquaculture practices. While a basic standard curriculum is provided by FAO, the trainings are tailored for specific ecosystems and level of aquaculture development in the countries; whenever possible, participants are exposed to field visits and exchanges, with the aim of enhancing a business acumen in aquaculture.

The technical principles addressed during the trainings include the factors affecting productivity, carrying capacity, growth rate and water management, classification of and introduction to farming systems, seed production, nutrition and feeds, harvest and post-harvest practices. The economic principles introduce the participants to the definition of commercial aquaculture, sustainability principles,

key terminologies in farm management, basic accounting and record keeping in commercial aquaculture, financial statements, business plan, assessment of the economic and financial viability of aquaculture farms, cost-structure analysis, sensitivity analysis, break-even analysis, financial analysis, cash flow analysis. In the

practical sessions, participants are introduced to the use of the User-Friendly Tool for Investment Decision Making in Aquaculture (UTIDA) through group exercises, presentations and plenary discussions using the technical principles and good management practices learnt during the first part of the training.

BOX 1 – Aquaculture as a business trainings provided in the last years

In the past four years, the following trainings have been provided at both regional and country level

In 2018:

- 10 to 14 September in Banjul, Gambia. Under the projects TCP/GAM/3603 “Support to enhancing the capacity of youth and women for employment in aquaculture” and GCP/RAF/254/MUL “Creating agribusiness employment opportunities for youth through sustainable aquaculture systems and cassava value chains in West Africa”: Participants from Gambia, Ghana and Nigeria.
- 25 to 29 June 2018 in Dakar, Senegal. Under the project GCP/RAF/254/MUL, the sub-regional training took place. Participants from Burkina Faso, Ivory Coast, Guinea-Bissau, Mali, Niger, Senegal and Togo.
- 7 to 11 May 2018 in Bissau, Guinea-Bissau. Under the project TCP/GBS/3604 “Validation et dissémination de systèmes intégrées d’aquaculture - agriculture (rizipisciculture et autres productions) à travers de l’approche Champs-Écoles des Producteurs”.
- 23 to 26 April 2018 in Zanzibar, Tanzania- Under the project GCP/URT/146/ROK “Development of Mariculture Sector in Zanzibar”.

In 2016:

- 14 to 18 November 2016 in Addis Ababa, Ethiopia. Under the projects GCP/SFE/001/MUL “Promoting Agricultural Diversification to Reduce Poverty, Fight Malnutrition and enhance Youth Employment Opportunities in Eastern Africa” and FMM/GLO/112/MUL “Blue Growth Initiative in Support of Food Nutrition Security, Poverty Alleviation and Healthy Oceans”. Participants from Burundi, Djibouti, Ethiopia, Guinea-Bissau, Kenya, Rwanda, Somalia, South Sudan and Uganda.
- 23 to 27 May 2016 in Kigali, Rwanda. Under the projects TCP/RWA/3502 “Support to Enhancing Development of Commercial Aquaculture (EDCA) in Rwanda” and GCP/SFE/001/MUL.
- 14 to 18 March 2016 in Kampala, Uganda. Under the project GCP/SFE/001/MUL
- 21 to 24 March 2016 in Kyrinyaga County, Kenya. Under the project GCP/SFE/001/MUL

In 2014:

- 20 to 24 January 2014 in Lusaka, Zambia. Within the framework of the project GCP/RAF/463/MUL “Programme in Support of the Implementation of the FAO Strategy for Fisheries and Aquaculture in Africa”. The NEPAD-FAO Fish Programme Workshop “Developing Aquaculture as a Business within an Ecosystem Approach to the Sector”. Participants from Benin, Burundi, Cameroon, Djibouti, Ethiopia, Ghana, Guinea-Bissau, Kenya, Mali, Mozambique, Nigeria, Rwanda, Senegal, Togo, Uganda and Zambia.



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BOX 2 – Aquaculture as a business knowledge product

Within the framework of the Aquaculture as a Business approach, the following practical manuals and tools were developed to support the capacity building process:

- The practical training manual is composed of two modules: Module 1 “The technical dimension of commercial aquaculture” and Module 2 “The economic dimension of commercial aquaculture”. The target users of both modules are trainers, educators, extension officers, small- and medium- scale fish farmers, commercial banks and financial institutions. The purpose is to enhance their knowledge and capacities in understanding and applying the basic technical, economic and financial principles and concepts of commercial aquaculture in their daily activities.
- The User-Friendly Tool for Investment Decision Making in Aquaculture (UTIDA).

The target users of both modules are trainers, educators, extension officers as long as are small- and medium- scale normally brought about by the participants for attracting investors to commercial aquaculture and positively influencing the long-term development of the aquaculture sector in sub-Saharan Africa.

Commercial aquaculture, which refers to fish farming operations whose goal is to maximize profits, is promoted for its potential contribution to food security and nutrition, and poverty alleviation directly by producing food fish and other products, and indirectly through employment creation and generation of income for the purchase of food. Commercial aquaculture equally contributes to the country economic growth and

balance of trade, which can assist countries to reach the Sustainable Development Goals (SDGs).

In summary, these trainings covered multiple topics, from technical to socio-economic

aspects. Participants discussed about the existing opportunities for aquaculture development, along with the political and private will to move forward the sector at country and regional level. Participants discussed about the factors hampering aquaculture development (e.g. market failures, the lack of capital, expert technicians, skilled labour, quality seeds, rations, equipment) and about the possible policy measures to tackle the issues (e.g. access to land, tax holidays, loan guarantees). The trainings provide also a platform for participants to share their opinions on how to improve the governance of the sector, as a necessary condition to fully realize its technical and commercial potential and ensure an orderly and sustainable development.

**SEE ALSO**

Martone, E. 2018 - *A User-Friendly Tool for Investment Decision Making in Aquaculture*. FAO Aquaculture Newsletter 58. April 2018. pp 54.
www.fao.org/3/i9200en/i9200EN.pdf



Hand feeding in a fishpond in Kenya

Promoting a Common Vision for the Sustainable Development of Aquaculture in Inhambane Province, Mozambique

Aiming to support the sustainable development of aquaculture in Mozambique, efforts are being made by the Ministry of Sea, Inland Waters and Fisheries to support aquaculture development including all the small-scale producers in the Province of Inhambane, through a training program and other forms of intervention. For this purpose, the Inhambane Province hosted from 16 to 17 May this year, a meeting for the strategic review of the Aquaculture Sector in the Province and the creation of an aquaculture platform in Inhambane Province.

The scope of an aquaculture platform is to promote dialogue and create partnerships for the sustainable development of aquaculture that can enhance compatible aspirations of the different actors involved in aquaculture value-chain on the one hand and, to promote relations between the public and private sectors through open and inclusive discussion, and provision of improved services. The meeting was attended by technicians from the Central and Provincial Fisheries Sector, producers of inputs, aspiring medium and small-scale aquaculture farmers, including the subsistence and commercial-oriented aquaculture producers. The meeting was facilitated by Provincial Directorate of



The aquaculture target group in the Province of Inhambane

Sea, Inland Waters and Fisheries of Inhambane with the support of FAO.

The intention of this meeting was to create for all participants, a space and opportunity to contribute with their knowledge and experiences, and also, to recommend the concrete actions for linking of the local actors in the value chain of aquaculture for their benefit.

Fish farming in Mozambique, particularly in Inhambane Province, is constrained by a number of reasons, including weak existing links between the various sector players, from small to medium scale producers, investors, feed and seed producers, traders and buyers. However, there are significant opportunities to enable the development of the aquaculture sector at provincial and national levels. The meeting held defined terms of reference for an innovative aquaculture sector platform tool - to encourage discussion and improve advocacy in the development of aquaculture in the province and country.



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Harvesting operations in a fish pond, Namibia

Seventh Annual Meeting of the Aquaculture Network for Africa

The Aquaculture Network for Africa (ANAF) is an informal network launched in 2006 currently composed by 14 Member countries¹. The main objective of the Network is to strengthen the capacity of Member countries to foster sustainable aquaculture development in Africa to fight poverty, ensure food security and nutrition, create wealth and income, and provide youth employment, particularly in rural areas.

At the sixth ANAF Annual Meeting held in Entebbe, Uganda in December 2016, it was recommended, and later endorsed by the 17th Session of the Committee for Inland Fisheries and Aquaculture of Africa (CIFAA) held in Banjul, Gambia in May 2017, to transfer ANAF from its temporary host at FAO/CIFAA, to the African Union Inter-African Bureau for Animal Resources (AU-IBAR) structure as a permanent home.

During the 33rd Session of the FAO Committee on Fisheries (COFI) held in Rome from 9 to 13 July 2018, the Heads of Delegation of Member countries of ANAF reiterated to COFI, their willingness to institutionalize the Network and confirmed their decision of integrating the Network within the AU-IBAR structure. Therefore, they requested the FAO Secretariat of CIFAA and AU-IBAR to make appropriate arrangements for an effective transfer.



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Participants at the 7th ANAF annual meeting, Nairobi, Kenya

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It is against this background that AU-IBAR in collaboration with the New Partnership for Africa's Development (NEPAD) Planning and Coordinating Agency (NPCA) and FAO, organized the Seventh ANAF Annual meeting. The meeting was held from 13 to 15 August 2018 at AU-IBAR office in Nairobi, Kenya. The meeting was attended by representatives from the ten ANAF affiliated African Union Member countries (i.e. Burkina Faso, Cameroon, Ghana, Kenya, Liberia, Mozambique, Nigeria, Senegal, Uganda, and Zambia), the ANAF Secretariat from FAO, and the Lake Victoria Fisheries Organization (LVFO) and AU-IBAR. The objectives of the meeting, facilitated by the ANAF Secretariat and LVFO through plenary sessions, included: (i) the elaboration of a SWOT (strengths, weaknesses, opportunities and threats) analysis of ANAF as a network to foster sustainable aquaculture development in Africa; (ii) the drafting of Terms of Reference (ToRs) for the ANAF Secretariat under AU-IBAR based on the SWOT analysis's results; (iii) the establishment of an interim ANAF Task Force to oversee the transition of ANAF from FAO/CIFAA to AU-IBAR and (iv) the drafting of a policy brief for the African Union containing the recommendation to integrate the ANAF Secretariat under AU-IBAR.

The meeting produced the following outcomes: (i) the status of implementation of ANAF activities; (ii) the ToRs for ANAF

Secretariat under AU-IBAR; (iii) the establishment of a Task Force composed by Cameroon, Nigeria, Kenya, Senegal and South Africa was nominated to oversee the implementation of the action plan; and (iv) a policy brief for the African Union containing the recommendation to integrate the ANAF Secretariat under AU-IBAR.

In addition to the above, the meeting highlighted the importance of sharing the outputs of the seventh ANAF Annual Meeting with non-ANAF Member during the Ministerial meeting. It was therefore recommended that the ToRs for ANAF Secretariat as an AU-IBAR entity and its proposed two-year transition action plan be further discussed in September 2018 with the African Union-Member States in order to obtain continental consensus on ANAF from them and their representative Ministers to strengthen ANAF and its institutionalization in AU-IBAR.

Finally, the meeting requested FAO and AU-IBAR to support the implementation of a two-year transition action plan including the facilitation of the selected Task Force to follow up on the key designated activities. The meeting highlighted the importance for FAO, LVFO and other African Union regional institutions, partners and the private sector to continue collaborating with the ANAF Secretariat.

¹ Cameroon, Chad, Ghana, Kenya, Liberia, Mali, Mozambique, Namibia, Nigeria, Senegal, South Africa, Tanzania, Uganda and Zambia

Development of Mariculture in Zanzibar, Tanzania

In an effort to contribute to food security and national economic growth, FAO joint forces with the Korea International Cooperation Agency (KOICA) and the Government of Zanzibar, Tanzania for the development of the mariculture sector. On April 20, 2018 Zanzibar inaugurated one Multi-Species Mariculture Project that includes one commercial hatchery for the production of juveniles of milkfish (*Chanos chanos*), sea cucumber (*Holothuria* spp.) and mud crabs (*Scylla serrata*), among other species. It is expected that the hatchery will produce about 10 million milkfish fingerlings, 1 million sea cucumber juveniles and 1 million crablets per year, from 2020. By that time it is also expected that 50 farmers will be fully operational using the same commercial production models that the FAO-KOICA funded project will instill in the community and private sector in Zanzibar.

The FAO-KOICA funded project for the development of mariculture sector, touches upon few of the services offered by the Zanzibar ecosystem such as



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The multi-species hatchery in Zanzibar

mangrove forests and seagrass. The success of this project, which include a long-term broodstock management plan, live bait production, holothurians-crabs-milkfishes larvae production, management of the hatchery, including elaboration of standard procedures and trained staff and to put in place commercial management of the activity. This will be achieved through the production of the target species on extensive or semi-intensive farming systems, in mono or polyculture in ponds and cages in mangrove forests.

Experimental production trials of holothurians and mud crabs hatchery-produced seeds started in early 2018 in Zanzibar.

The project also aims at developing a mariculture sector that promotes food security to prosperous and competitive producers while conserving the Islands' ecosystems and biodiversity. Mangroves provide a

wide range of ecosystems services with a direct impact on the livelihoods and food security of local communities. Some of them refer to the provision of timber and non-timber products.

Concomitantly, mangroves compete with urban development along the coasts of Eastern African countries, Tanzania (Zanzibar) included, and are threatened with degradation and extinction.

As one of the most established touristic economies in Africa, Zanzibar aims at preserving indigenous traditions and values, on one hand, while keeping up with the rapid social development and economic growth, on the other. Zanzibar's natural resources, including mangroves, offer attractive touristic destinations, rich biodiversity and a substantial array of goods and services. Unfortunately, often, mangroves and other wetland ecosystems are considered wastelands

because their values are not fully appreciated, even when fully utilized by the local and tourist population. To bring forth these values, awareness has to be raised about the importance of the different services offered by the mangroves. The value of the Zanzibar ecosystem needs to be studied and brought to light to support decisions-makers in mangrove conservation on the Island.

The production of crabs, sea cucumber and milkfish by the project, cannot be seen as a standalone production system but within the context of preserving and enriching the existing ecosystems in the Island and in the region. Ideally, the integrated multi-trophic aquaculture (IMTA) should integrate high-value species such as the above-mentioned ones to recover cost of investments and earn income for the farmers.

Based on the experimental results, fed species (e.g. milkfish) may be introduced in deeper waters and will be cultured in floating cages, together with seaweed and sea cucumber or other bottom-feeders. In the existing shallow lagoons, where seaweed is farmed, the project will introduce sea cucumber and milkfish. Synergies using the current hatchery project in Zanzibar, dedicated to the production of sea cucumber and milkfish, with the established seaweed industry is beneficial to all farmers and the Island at large.

The supply of fingerlings and feeds are crucial to the success of milkfish farming, therefore, the hatchery and nurseries operated initially by the government will provide an inexpensive source of fingerlings to farmers. Eventually, the private sector will play the most important role in partnership



FAO trains aquaculture technicians to operate the hatchery

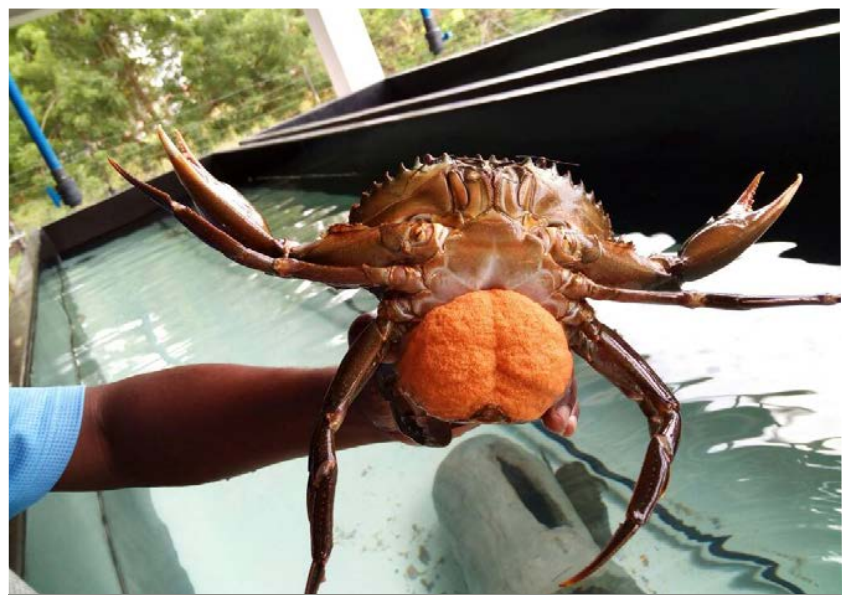
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with Government to operate business-oriented hatcheries and farms. In addition, feeds that need to be supplied to grow the fish from young to harvestable size can be sourced commercially and can be produced using local raw materials that include the farmed Eucheumoid algae (e.g. *spinosum* and *cottonii*) and the sea lettuce (*Ulva lactuca*). More research to find alternative feeds, including locally available plant-based materials (e.g. seaweed, soya) could lead to the development of low-cost, high-protein feeds for fish farming.



Sea cucumber broodstock

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Mud crab broodstock

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New Project in Support of the SADC Fisheries and Aquaculture Programme



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Fish farmer feeding her fish in a floating cage

Aquaculture plays a critical role as it is a source of income and is central to food and nutrition security. In Southern Africa, FAO and Southern Africa Development Community (SADC) launched a technical cooperation programme (TCP) to facilitate the implementation of the SADC Fisheries Programme, and build capacity of Member states in domesticating the SADC Protocol on Fisheries.

The SADC Fisheries Programme has not been effectively implemented due to the past capacity constraints and lack of funds. The launch of the project comes at a time when there has been a shift towards promoting Blue Economy in the Region, and fisheries and aquaculture sectors are identified as the key drivers of the Regional Blue Growth Initiative.

The FAO/SADC TCP was launched during the 6th meeting of the *SADC Aquaculture Working Group*, held back to back to the 2nd meeting of the *FAO Platform for Genetics and Biodiversity Management in Aquaculture* from 30 April to 3 May 2018 in Lilongwe, Malawi. The project will provide support to implementation of the SADC

Regional Aquaculture Strategy and Action Plan. Regional guidelines for good practice aquaculture management based on the Ecosystems Approach to Aquaculture will be developed in close consultation with SADC Members. The project will also allow to strengthening the cooperation between SADC and FAO towards the development of sustainable aquaculture in the region.

Additionally, a tool for monitoring domestication of the SADC Protocol on Fisheries in the Member states will be developed, validated and implemented. This tool will be closely aligned with the FAO Subregional Office for Southern Africa, the Southwest Indian Ocean Fisheries Commission and Benguela Current Commission.

FAO support to the SADC Secretariat is expected to result in strengthening the development and implementation of regional and country specific aquaculture initiatives in the future. The meeting reviewed the SADC aquaculture programme, in particular through the updating by Member states of their national aquaculture programmes and strategies.



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Man holding a farmed Nile tilapia (*Oreochromis niloticus*) in Zambia



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World Aquaculture - The Next 20 Years

Aquaculture is a thriving and important food supply sector worldwide, and yet is capable of much more expansion and improvement. The main question is - will aquaculture be able to meet expectations to provide an additional 40 million tonnes of fish per year by 2030? This is the level of production which will be needed to maintain current levels of fish consumption for an expanding world population. Aquaculture is a relatively young activity showing substantive growth as a commercial viable activity since the 70's. Scale of production is very variable, what lessons can be learned from regions and countries where aquaculture has matured into an industrial production scale. Can we also bring in good examples from other similar agrosectors, e.g. the



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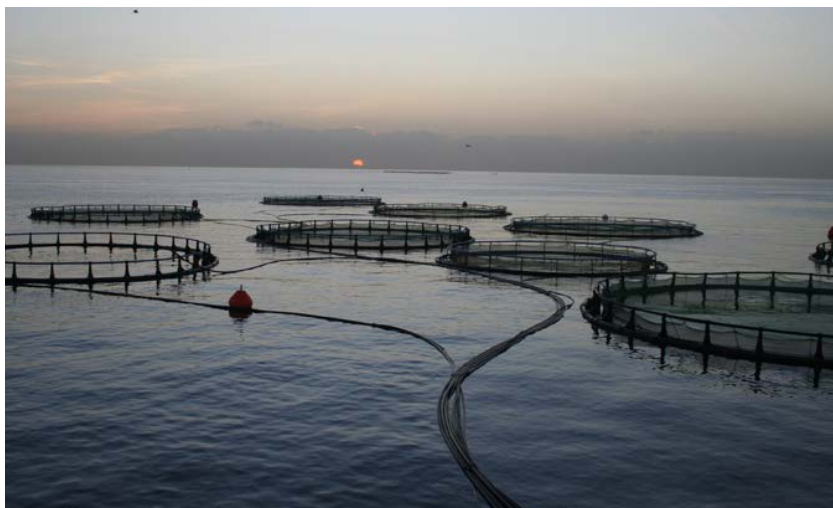
case of poultry farming? Although it is estimated that 80 percent of current aquaculture production is derived from animals low in the food chain such as herbivorous, omnivorous fish and molluscs, some systems rely partially, or in some specific phase of their production cycle - fully, on artificial compounds feeds.

Among the many benefits that aquaculture provide for society, and one of its main driver as a food producing sector, is the example from Asian countries on combining paddy rice with aquaculture. Here some of the practices employed today have been shown to increase productivity, producing more with less, to help satisfy the demand of a rising and increasingly urbanized global population.

Along within these issues, we have been observing an increase in aquaculture productivity, among other things, due to the intensification of production methods. In Asia, small-scale traditional pond aquaculture used to be the main driver of aquaculture production where a range of low trophic level species

with complementary feeding behaviors were stocked in fertilized ponds, mainly carps species. This form of production is slowly giving way to other farmed fish species and crustacean production that is heavily, if not exclusively, reliant on feeds. Key drivers of this trend have been the rising land prices and the higher revenues obtained from those systems, which makes feeds affordable (Beveridge *et al.*, 2013). On the other hand, a recent study performed an analysis which demonstrated that suitable space for developing marine aquaculture is not the limiting factor for aquaculture development, but economics and governance can be one of the main growth impediments. This suggests that vast amount of space suitable for marine aquaculture is available presenting an opportunity for countries to develop aquaculture in a way that aligns with their economic, environmental and social objectives (Gentry *et al.* 2017).

We have been registering a strong annual aquaculture growth (around 5 percent) worldwide



Floating cages in Cyprus

in the last 20 years. Moreover, despite the fact that around 60 percent of the fish grown are in the non-fed systems, i.e. fish or aquatic organisms do not depend on external feed supply. But one of the main issues still faced to aquaculture growth, and its capacity to fulfill the fish gap needed to achieve the projected 2030 demand, is how to provide the growing need for fish meal and fish oil without relying on to obtaining it from the wild fish stocks, or better yet, how to not rely at all from those. We already have all the background and science needed in order to produce a zero fishmeal and fish oil diet, using other sources. What is needed now is a strong commitment from the aquaculture sector, and specifically, from the feed manufacturers, to translate existing technology and start to venture in those alternatives sources in order to accomplish this fish feed free from fishmeal and fish oil. Further still, to guarantee that all the nutritious quality from those fish products fed and raised with those alternative sources is not compromised and is still of adequate quantity, similar or better than the products derived from the wild.

In this new world order we will probably see some emerging trends in the aquaculture feed

industry. In the near future these will include, among others: the use of transgenic plant(s) to produce and accumulate omega-3 fatty acids in their seeds with the addition of synthetic genes based on those present in marine phytoplankton (Ruiz-Lopez *et al.* 2014); new sources of protein and omega-3 fatty acids; insect based meals; single cell proteins; bacterial protein; synthetic food; and functional aquafeeds.

A key trend is that we will likely see strong growth towards those fish and crustaceans fed in semi intensive and intensive systems, due mainly to improving market prices, as producers seek higher returns. We also need to have a different approach in order to have a sustainable outcome in the foreseeable future, where current availability share of the ingredients

come from reduction fisheries (fish meal and fish oil) reported to account for over 30 percent of global landings of marine fish annually (Alder *et al.* 2008).

As aquaculture expands we will be faced with new and different challenges such as the uncertainties due to climate change scenarios, ocean acidification, systems intensification, prevalence of existing and emerging diseases. One way to keep ahead of those challenges, fulfilling FAO's role for the development of the aquaculture sector, is further and stronger country and regional engagement in Blue Growth Initiatives. A strong driver in this will be better public-private partnerships in different aquaculture capacities and scenarios, where we can use the best methods and technology available to those that still lack the capacity but have the potential to develop a strong aquaculture sector.

It will be necessary to increase our knowledge base focusing on regional priorities and demands. In national policies and programmes, we will need to use best-case, science based scenarios, to implement useful policies by country, increase capacity building with in the field trainings of trainees, all closely aligned and integrat with the goals and targets of the UN 2030 Agenda for Sustainable Development.



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Ruiz-Lopez, N., Haslam, R.P., Napier, J.A., Sayanova, O. 2014. *Successful high-level accumulation of fish oil omega-3 long-chain polyunsaturated fatty acids in a transgenic oilseed crop*, 77(2):198-208.

Preparation of the State of the World Report on Aquatic Genetic Resources

Aquatic genetic resources (AqGR) are fundamental to the future of global fisheries and aquaculture, their effective management is critical to the future health and adaptive capacity of our fishery stocks and they are the resource on which the future of aquaculture will be developed. FAO Member countries already report on the aquatic species that are being farmed. However there are numerous farmed types below the level of species that make aquaculture more productive and profitable, which are not well recorded or reported.

FAO, including its Commission on Genetic Resources for Food and Agriculture (the Commission), the Fisheries and Aquaculture Department and other departments, has long been actively engaged in promoting the conservation, sustainable use and development of genetic resources. The first State of the World Report, on plant genetic resources, was published in 1997¹



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followed by a second report a decade later². Similar reports have been published on animal genetic resources (FAO, 2007³ and 2015⁴) and forest genetic resources (FAO, 2014⁵). These reports have raised awareness of the value of genetic resources for food and agriculture and acted as catalysts for further work, including in some cases, the development of Global Plans of Action, which have contributed to the more effective management of these resources.

In 2007 Members of the Commission recommended the development of a report on the State of the World's Aquatic Genetic Resources for Food and Agriculture (the Report), with a focus on species used in aquaculture and their wild relatives, within national jurisdiction. A decade later this Report is about to be published.

The purpose of the State of the World Report

There are two major objectives in the preparation of the Report. Firstly to raise awareness of the status and importance of countries' aquatic genetic resources (AqGR). Secondly the Report itself provides a snapshot of the current global status of AqGR which can be used as a reference point for planning and management now and in

the future. It is hoped that the country reports will become national policy and guidance documents.

The process

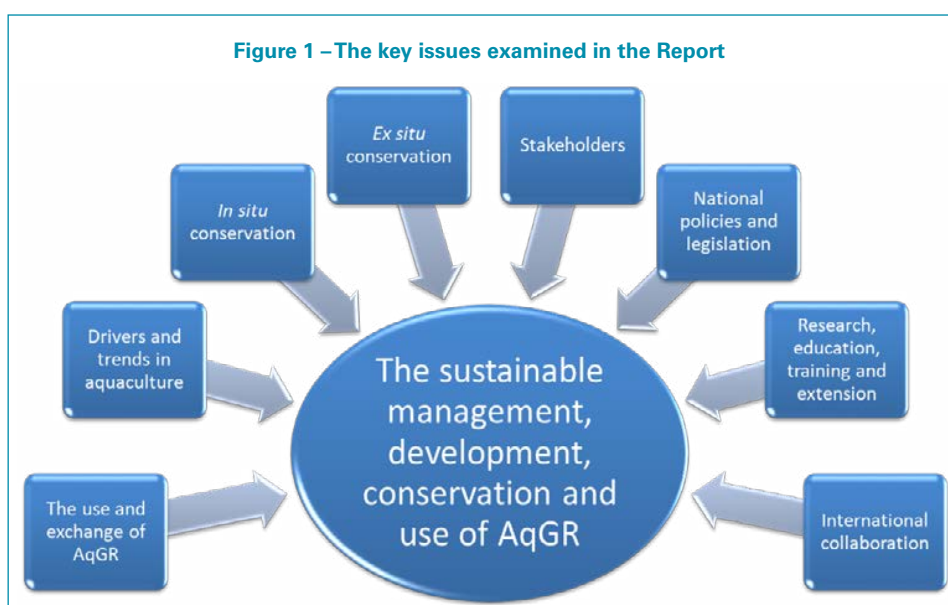
The Report is based on country responses to a questionnaire completed by National Focal Points (NFPs). In the lead up to the distribution of the questionnaire, regional workshops were held to train NFPs to enhance capacities to accurately and fully complete the questionnaire. The questionnaire⁶ is comprehensive and relatively time consuming, but eventually responses were received from 92 member countries, whose geographical distribution is shown in the accompanying chart. These countries represented more than 96 percent of global aquaculture production and over 80 percent of capture fishery production, and included the top ten aquaculture producing countries. The questions covered eight key issues around AqGR which form the basis of the main chapters of the Report (see Figure 1).

The challenge of non-standard nomenclature

One of the challenges in completing the questionnaire, and also in preparing the Report, was the lack of harmonization of some key terminology. For example,

- 1 FAO. 1997. *The State of the World's Plant Genetic Resources for Food and Agriculture*. Rome. www.fao.org/3/a-w7324e.pdf
- 2 FAO. 2010. *The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture*. Rome. www.fao.org/docrep/013/i1500e/i1500e.pdf
- 3 FAO. 2007. *The State of the World's Animal Genetic Resources for Food and Agriculture*. Rome. www.fao.org/3/a-a1260e.pdf
- 4 FAO. 2015. *The Second Report on The State of the World's Animal Genetic Resources For Food and Agriculture*. Rome. www.fao.org/3/a-i4787e.pdf
- 5 FAO. 2014. *State of the World's Forest Genetic Resources*. Rome. www.fao.org/3/a-i3825e.pdf
- 6 www.fao.org/3/a-bp506e.pdf
- 7 FAO. 2016. *Incorporating Genetic Diversity and Indicators into Statistics and Monitoring of Farmed Aquatic Species and Their Wild Relatives*. Rome. www.fao.org/3/a-i6373e.pdf

aquaculture strains can be referred to variously as stocks, populations, breeds, lines, land races etc. In preparing the Report we have attempted to standardize some of this terminology, including a relatively new term “Farmed Type” (see Table 1) drawing on the outputs of an expert workshop on ‘Incorporating Genetic Diversity and Indicators into Statistics and Monitoring of Farmed Aquatic Species and Their Wild Relatives’ (FAO, 2016⁷).



The key characteristics of AqGR

In preparing the Report, and comparing it with the State of the World reports for other sectors, it is possible to identify some of the key characteristics of AqGR and how they contrast with those of other agricultural sectors. The following are some of the key

characteristics of AqGR identified in the Report:

- The large number of species farmed.
- The relatively small numbers of developed farmed types (see Table 2).
- Paucity of information on AqGR below species level.
- The relative infancy of development of domesticated

AqGR, i.e. the high proportion of ‘wild types’ that are farmed.

- The important dependency on Wild Relatives in both fisheries and aquaculture.
- Many populations of wild relatives are declining in the wild.
- The high levels of genetic variation present in domesticated AqGR relative to other sectors.

Table 1 – Some of the key definitions standardized in the report

Term	Definition
Farmed type	Farmed aquatic organisms that could be a strain, hybrid, triploid, monosex group, other genetically altered form, variety or wild type.
Strain	A farmed type of aquatic species having homogeneous appearance (phenotype), homogeneous behaviour and/or other characteristics that distinguish it from other organisms of the same species and that can be maintained by propagation.
Stock	A group of similar organisms in the wild that share a common characteristic that distinguishes them from other organisms at a given scale of resolution.
Variety	A plant or grouping of plants (including aquatic plants) selected for desirable characteristics that can be maintained by propagation and have characteristics that easily distinguish it from any other known variety; the variety must retain these characteristics under repeated propagation.
Wild relative	An organism of the same species as a farmed organism (conspecific) found and established in the wild, i.e. not in aquaculture facilities.

Table 2 – Table summarizing some of the key features of genetic resources in the different sectors of food and agriculture

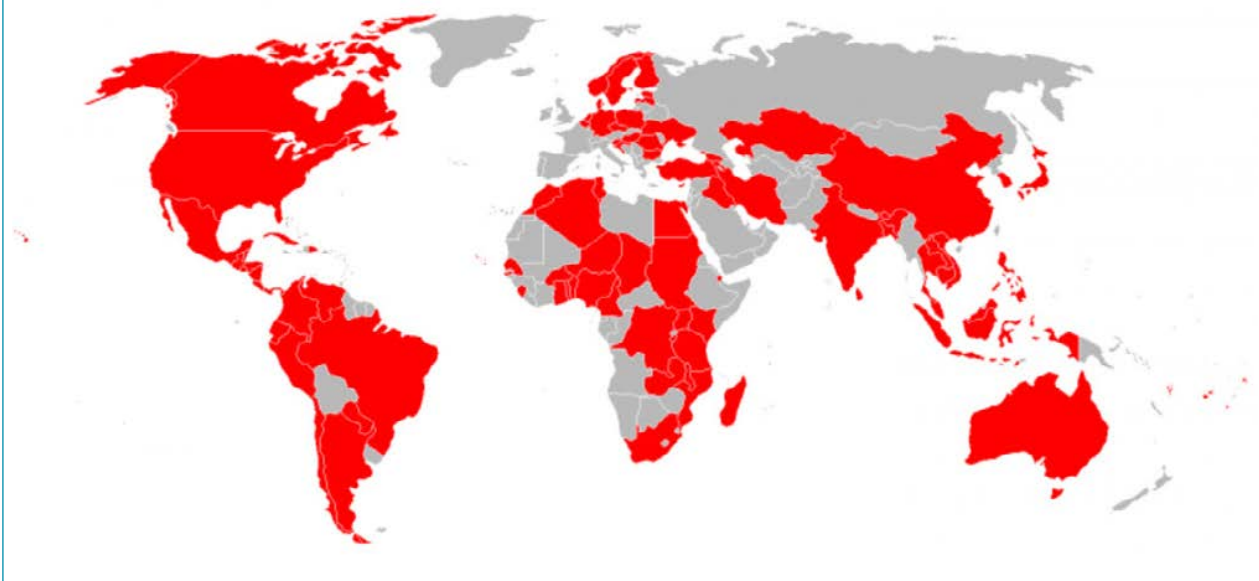
Sector Genetic Resources	Farmed	Number of major farmed species	Number of strains/breeds/varieties
Plant	6 000	9 ^a	~7 400 000
Livestock	37	5	~9 000
Forests	7 900	2 400 ^b	~700
Aquatic Genetic Resources	554	17 ^c	N/A

^a These species make up 2/3 of crop production (FAO, 2017)*; ^b Forest trees actively managed for the products they supply;

^c These species make up 2/3 of aquaculture production;

* FAO. 2017. FAOSTAT. [Cited 8 May 2018]. www.fao.org/faostat

Figure 2 – Map showing the countries reporting on their Aquatic Genetic Resources via the questionnaire



- AqGR are often a common resource and access and benefit sharing systems are underdeveloped.
- Relatively few *ex situ* conservation programs and the importance of *in situ* conservation.
- Limited capacity in AqGR management, sustainable use and conservation relative to other sectors.
- National policies and legislation often do not explicitly include AqGR.

The launch of Report and next steps

The Report is currently being reviewed by FAO and international experts including the FAO Committee on Fisheries (COFI) Advisory Working Group on Aquatic Genetic Resources and Technologies and is expected to be launched late 2018 or early 2019. FAO hopes that the Report will stimulate further development and sustainable use of AqGR in an environmentally and socially responsible manner. Efforts are currently underway to use the information in the Report to develop a registry of farmed

types to develop a registry of farmed types, to promote the use of standard terminology, and to document how genetic resources.

The Intergovernmental Technical Working Group on AqGR (ITWG-AqGR), held a meeting in April 2018, recommending the development of a Global Plan of Action to promote the conservation, sustainable use and development of Aquatic Genetic Resources, a recommendation that will be considered by the

Commission and COFI (and its various bodies) in their forthcoming sessions. A Global Plan of Action could be an effective instrument to promote the conservation, sustainable use and development of AqGR to address the challenge of a growing population, changes in consumer demand, competition for resources, habitat degradation and loss and the direct and indirect effects of climate change.



There are many farmed types referred to in the country reports, such as these red tilapia, but do we know if they represent true strains?

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Lesson to be learned from Aquaculture Development in China: Human resources, Technology innovation, Extension and Governance

The State of the World's Fisheries and Aquaculture (FAO, 2018) states that global aquaculture production (including aquatic plants) in 2016 was 110.2 million tonnes. China produced 49.24 million tonnes of food fish in 2016, representing 61.5 percent of total world production). China is by far the major producer of farmed food fish, producing more than the rest of the world combined every year since 1991. Aquaculture's share of total Chinese seafood production has steadily increased to 73.7 percent in 2016, and this proportion is expected to expand further (FAO, 2018).

Aquaculture development in China: the role of public sector policies

FAO Fisheries Technical Paper 427 (Hishamunda and Subasinghe, 2003), summarized the policies that have underpinned aquaculture development in China over the last three decades. These policies provided strong guidance and support to fast and sustainable aquaculture development. The policies included: the development of employment resources; aquaculture as a priority;



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Nursing tilapia fry, China

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establishment of aquaculture production bases; promotion of sustainable aquaculture development; continuous adjustments in the structure of the aquaculture sector. The policies further addressed specific needs through a specialized agencies leading, inter alia, to: establishment of a good legal, regulatory and administrative frameworks for aquaculture management and development; emphasis on research, technological development and information dissemination; and promotion of high commercial value species.

Analysing the current development status and gaps that exist between China and other developing countries, it is evident that there are basic policy components that need to be emphasized in support of aquaculture development. This article examines the key elements that have underpinned

the rapid and massive expansion of aquaculture in China and identifies lessons that we can learn in promoting aquaculture development in other regions. These are the following: (i) the human resources; (ii) research and technology innovation; (iii) extension service; and (iv) aquaculture governance.

Human resources and capacity building

Employment in aquaculture management and production is an essential factor in aquaculture development. If there is not enough number and quality of labourers and technicians for employment then aquaculture development would be constrained and would deliver poor results, no matter how good the policy or how high the investment.

China started professional training courses on aquaculture dating back to 1910. Tianjin and Shanghai, the two major coastal cities in China, were

the first places to establish vocational schools for fisheries and aquaculture. In 1946, Shandong University established its department of fisheries, which was the first faculty for fisheries and aquaculture in China. Now there are 52 universities in China providing bachelor degrees and higher education programs in aquaculture, and there are about 4 000 graduates each year. In addition there are more than 40 vocational schools across the country that provide programs on aquaculture in China, and train about 6 000 personnel and labourers annually. This well-established education system contributes to important human resources in sustainable aquaculture industry research and development in China.

Research and technology innovation

Aquaculture research is a kind of applied research on new technology adoption, testing of innovated aquaculture species, production system models, etc. The success of aquaculture practice depends greatly on the full understanding of the biology, physical chemistry, and local situations and conditions. A successful aquaculture business also depends on species and strains, water, land, breeding, feeding and the strength of the market, as well as acceptance by the local community. Evaluation and eventual success of any new approaches, species and/or production models relies on good quality basic and applied research to verify practical and commercial feasibility before any scaling up and commercialisation occurs in the country.

There are national, provincial and private research agencies in China. Universities and research institutions provide strong support in technology



Harvesting tilapia from a pond, China

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innovation and development. Apart from the universities, the Chinese Academy of Sciences (CAS) is leading the fundamental science and technology research on hydrobiology and marine ecosystems. The Chinese Academy of Fishery Sciences (CAFS) is the national lead institution in fishery and aquaculture research and technology innovation. CAFS has nine research institutes and four pilot stations, geographically scattered near major rivers and seas in China. There are also provincial and private research agencies for aquaculture technology demonstration and extension. At present there are more than 3 000 specialized professional experts from research institutes engaged in aquaculture research and development in China. They are the major contributors to the development of local aquaculture technology and best practice establishment.

Extension service and modern aquaculture system

Due to the imbalance of information in the aquaculture production/value chain, farmers need efficient and adequate technical support from extension officers. China has the biggest aquaculture extension system in the world, there are about 60 000 professional aquaculture extension officers in China.

They are allocated from central government to the town/village level, and help farmers in realizing their dream in doing aquaculture as business.

Modern aquaculture business development requires farmers to form their own businesses fulfilling specific roles in the production/value chain. This promotes efficiency in job allocation and utilization of natural resources in the country. China has established five modern aquaculture technology innovation and support systems, funded by government, i.e. conventional carps, tilapia, shrimps, shellfish, and flat fishes. Led by a chief scientists and several principal scientists from recognized research institutes or universities, each extension system is supported by a national network of researchers, extension officers plus farms/hatcheries, feed manufactures and processing companies. The systems cover the major cultured species in China, i.e. conventional carp species, high-value freshwater species (include tilapia), flatfish and other marine finfish, marine and freshwater shrimps and molluscs. The extension systems focus on the policy, quality seed supply, feed, aquatic animal health management, grow-out systems, processing, marketing, as well as



Sorting tilapia fingerlings for sale, China

the organization and support for production and value chains.

Improved aquaculture governance

Aquaculture governance includes zoning, planning, monitoring and inspection, food quality control, and monitoring and management of social and ecological environment impact. China improved its aquaculture governance capacity and knowledge along with its development of modern aquaculture. Issues such as better zoning and planning have been extended from the major production areas to areas across China. Law enforcement teams for monitoring and inspection have been extended from the central government down to the level of the township. Food quality control and traceability has been extended from the major export farms now to all farms, and from processing to the whole production chain.

Recently, China has paid more attention and prioritised ecological sustainability in aquaculture development by publishing policies and guidelines on ecological and environment friendly aquaculture practices. There is a recognized need to conduct carrying capacity evaluations for all major aquaculture areas in China, in order to set up a modern aquaculture planning system, and promote large-scale development

in a rational way. There are priorities on developing ecosystem-based aquaculture, further strengthening the building of aquatic (marine and

inland) protected areas and special protected water areas (SPWA), and progressively establishing self-sustaining aquaculture ecosystems. The transformation of operation modes should be accelerated and progress guided towards large-scale and sustainable development. By promoting the concept of integrated multi-trophic aquaculture (IMTA), it will be necessary to actively explore popularization of ecosystem-based aquaculture and, to search for new routes for upgrading extensive aquaculture, so as to fully display the food provision and eco-service functions of aquaculture systems, and create a modern aquaculture production system.

In conclusion, aquaculture development is a policy driven industry. Policy drivers have been improved in many countries in Asia and other regions. Based on analysis and observation in less aquaculture developed countries, these seem to place less priority on policy to support production and industry development. Extracting lessons from the successful experience from China, there is a need to enhance training/education programs to support growth and quality in aquaculture employment. There is also a need for capacity building for management and production personnel. Further, support should be provided to improve

aquaculture research mechanisms and capacity, including to extension programmes. Improved aquaculture governance will lead to increases in the aquaculture production chain to benefit more people who have the potential to build aquaculture as a business leading to poverty reduction and rural development worldwide.



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Conservation and Management of Aquatic Genetic Resources: Technical Exchange Visits between Zambia and Hungary

FAO organized and facilitated a bilateral technical exchange between Zambia and Hungary as a core activity of the FAO project titled “Enhancing the contribution of Aquatic Genetic Resources to food security”. The project was led by FAO with the support of the German Government and was developed to meet the requests of member countries for support in the assessment of the current status of their Aquatic Genetic Resources (AqGR) and to identify



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the major gaps, limitations and needs for their conservation, sustainable use and development.

Zambia is recently experiencing a rapid expansion of aquaculture and the Government is investing efforts towards a responsible development of national AqGR. For this reason the country was considered as an ideal target for the implementation of the FAO project.

Based on these premises, the following three top-level Hungarian institutions with expertise in gene conservation, selective breeding programmes and scientific research on AqGR have been engaged in the project: the Research Center for Farm Animal Gene Conservation (HáGK), the Szent István University and the Research Institute for Fisheries and Aquaculture (HAKI).

Experts from the Hungarian institutes provided technical

support to the Department of Fisheries (DoF) of the Zambia Ministry of Fisheries and Livestock during reciprocal exchange visits. The expected output was that, through this technical support, the DoF will increase its capacity to sustainably develop, manage and use the national AqGR.

The first technical visit took place from 25 February - 09 March 2018 when a delegation of three Hungarian geneticists travelled to Zambia. Activities consisted of field visits to Government facilities, universities and private farms, including: the National Aquaculture Research and Development Centre (NARDC) which is supported and managed by the DoF; the University of Zambia; Kafue Fisheries farm, Kalimba Fish farms, Miyenge farm, Msekese Fisheries farm.

To carry out a detailed analysis of national gaps and needs related to AqGR, the Hungarian



Fish harvesting in a fishpond

geneticists used a technical guideline previously developed by FAO under the same project and entitled “Framework of minimum requirements for sustainable use, management and conservation of aquatic genetic resources of relevance for aquaculture”. This exercise was also used to further test the effectiveness of the Framework as a tool to determine the current status of a country in the development of its AqGR.

At the end of this first visit, a half-day workshop on “Management of the Aquatic Genetic Resources” was organized by FAO where the Hungarian experts presented their findings and made recommendations on conservation of AqGR in Zambia. Some of the key recommendations include: (i) a substantial genetic characterization of individuals used in breeding programs and (ii) the

establishment of a gene bank for a long-term maintenance of the genetic variability of main species used in national aquaculture.

In the second mission of the technical exchange, a delegation of three Zambian national officers from DoF went to Hungary, in May 2018. During this study tour, the delegation was trained in broodstock management and breeding programs and conservation of AqGR through the: collection of DNA samples; Passive Integrated Transponder (PIT) tagging of individuals maintained in a ex situ in vivo gene bank; hands-on laboratory work needed for genetic characterization; cryopreservation of sperm for an in vitro gene bank; field visit to private farms; electrofishing demonstrations in different natural habitat; and lectures on gene conservation.

Based on lessons learned, at the end of the mission, the Zambian delegation was able to identify possible gaps in ongoing projects on AqGR in their country and make proposals on how to use the acquired knowledge to address the recommendations made by Hungarian delegation during the first visit exchange held in February 2018.

This technical exchange laid the ground for possible following-up collaborations among the two countries and some follow-up actions were discussed. First, the Zambian delegation expressed the intention to explore the opportunity to organize a study tour to Hungary for selected top government officials from Zambian Ministry of Fisheries and Livestock. Second, the Szent István University proposed an International Credit Mobility programme as a possible way for the two countries to exchange PhD students and teaching staff.

An in-depth analysis of national gaps and needs as well as the lack of technical skills and specialized resource persons are among the major constraints to an efficient use of the AqGR in developing countries such as Zambia. Fostering fruitful bilateral cooperation can offer a valuable contribution to national stakeholders, such as the Zambian DoF, to overcome country limits to a sustainable scaling up of aquaculture.



Training on electrofishing



SEE ALSO

Lucente, D., Stankus, A., Halwart, M. & Bartley, D. 2018. **Necessary elements for the development and management of genetic resources in aquaculture**. FAO Aquaculture Newsletter, No. 58, pp 52–53.

Aquatic genetic resources website: www.fao.org/aquatic-genetic-resources

Approaching Fifty Years of the Aquatic Sciences and Fisheries Abstracts (ASFA)

Access to information is vital for all aspects of aquaculture work - whether that be compiling best practice guidelines, technical manuals, making international policy-making decisions or researching a thesis. The advent of the internet and Google has meant people have access to more information than ever before - but finding useful and trustful information can be challenging. For this reason, with ASFA approaching its 50th year anniversary it felt appropriate to ask: *What should ASFA look like at fifty?*

ASFA and aquaculture

The ASFA database contains over two hundred thousand aquaculture bibliographic records that have been carefully curated and recorded by ASFA Partners around the world.

To illustrate the coverage of aquaculture in ASFA here is a list of possible search results in the database:

- Aquaculture and Biosecurity - 369 results (8 published within last 12 months)
- Integrated and Multi-Trophic Aquaculture - 786 results (24 published within last 12 months)



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Participants at the ASFA Advisory Board Meeting in Ostend, Belgium

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What is ASFA?

The Aquatic Sciences and Fisheries Abstracts (ASFA) database is the premier reference in the field of aquaculture, fisheries and aquatic sciences. The overall objective of ASFA is to disseminate information to the world community of aquatic scientists, bearing in mind the special interests of developing countries in this field.

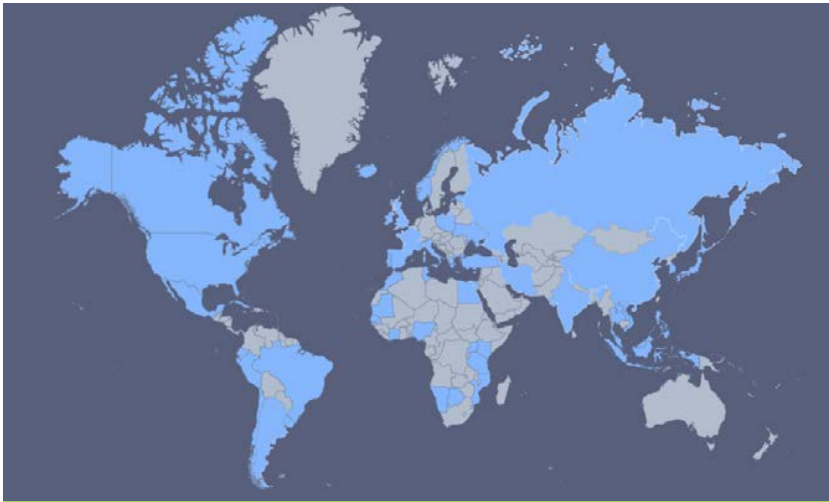
Input to the ASFA database is provided by a growing international network of information centers monitoring over 3 000 serial publications, in addition to books, reports, conference proceedings, translations and grey literature. The unique partnership arrangement of ASFA ensures literature from institutions that would often be difficult or time consuming to find, is made available on one database. Published since 1971, the ASFA database at present contains more than 2 500 000 records.

- Aquaculture and Probiotics/ Prebiotics - 1 524 (67 published within last 12 months)
- Aquaculture and Genetics - 10 630 results (83 published within last 12 months)
- Aquaculture and Climate Change - 1 992 results (81 published within last 12 months)
- Aquaculture and (GIS or Mapping) - 1 346 results (18 published within last 12 months).

ASFA Advisory Board Meeting

The ASFA Advisory Board (ABM) held its 47th Annual Board Meeting at the Intergovernmental Oceanographic Commission (IOC) Project Office for International

Oceanographic Data and Information Exchange (IODE), from 11-15 June 2018 in Ostend, Belgium. Peter Pissierssens (Head of the UNESCO/IOC Project Office for IODE), opened the meeting by outlining the challenges presented by the proliferation of Google scholar among researchers, students and scientists. His thoughts were echoed by Marc Taconet, Head of FAO Fishery Statistics and Information Branch, who addressed partners by saying the need for change was vital to ensuring ASFA remains a relevant information product in an increasingly competitive global environment.



Global map of ASFA's geographical coverage

The ASFA ABM was attended by 36 participants representing 33 partners (28 National ASFA Partners, 2 UN ASFA Partners, 2 International ASFA Partners, the ASFA Publishing Partner) partners who had a great deal of enthusiasm and expertise to meet these challenges and worked during the whole meeting to

come up with concrete actions for ASFA:

- More analysis to understand and meet the needs of end users.
- Build a stable partnership of partners around the globe.
- Cover more literature on its database, potentially by harvesting records from

countries and partners being concentrated on enriching the data base with grey literature and hidden information.

At the heart of these changes is the need to meet the information needs of scientists, researchers and students, decision makers, aquaculture and fisheries officers, and private sector.

The next ASFA Board Meeting is scheduled to take place in September 2019. We hope by then to have made progress on the above points and that ASFA will be well on its way to celebrating its 50th year anniversary in 2021 as a valued and useful information product.



SEE ALSO

ASFA website:

www.fao.org/fishery/asfa

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Aquaculture Production and Marketing in the Roman Empire

Humans have been farming aquatic species since the beginning of history. The origins of aquaculture may not be too far different in time from those of agriculture and livestock production



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Ancient Roman artificial caves in Ponza Island (Central Tyrrhenian Sea) used to farm Mediterranean moray (*Muraena helena*)

during the Neolithic revolution. Different forms of fish stocking and farming were present during the rise of early civilizations in Asia and

the Middle East. Tilapia farming is evidenced by archaeological findings and described by Herodotus in the second book

of his "History", written in late 5th century BC. In the succeeding centuries the Mediterranean civilizations undertook a process of cultural exchange boosted by the development of trade and military conquests. Such a process of early 'globalization' culminated with the whole Mediterranean Sea under Roman control during the reign of Augustus (27 BC-14 AD). The process of Romanization did not just transfer Roman values and lifestyle to the communities under their control, but also served also as a vehicle for sharing knowledge and technology across the different nations ruled under the Roman Empire.

It is thought that aquaculture was playing a role in the Roman food industry and markets, as early as the late first century BC. Evidence of active and potentially profitable aquaculture activity can be seen in archaeological remains all over the empire like the fish farms of S'Argamassa in Spain or Lambousa in Cyprus, as well as in contemporary written documents. Evidence of aquaculture is not just noted in written sources but also exhaustively described in the most celebrated ancient Roman treatises of biology and agriculture. The main references about technology, production and marketing of aquaculture species are found in Varro's (116-27 BC) "*Agricultural Topics in Three Books*", in the book IX of Pliny the Elder (23 AD-79 AD) "*Natural History*", and in Columella's book VII "*On Agriculture*". All these works have been preserved complete until our days. From these three authors we now know that Roman aquaculture had several different motivations. The most evident was the strong consumption of seafood among the population, especially among the upper classes. Such volumes of demand and high prices made aquaculture a potential source of

income and an opportunity for a profitable business for land owners in coastal areas. Varro and Pliny report several tales of economic success. Perhaps the best known example of success was the oyster farmer Sergio Orata, an engineer in the first century BC, who made a big profit by promoting oyster consumption across the senatorial class and highlighted the special conditions of his farms in Lake Licrino as an incipient example of the use of geographical differentiation as a marketing tool. On the other side there is also the case of General Lucullus who spent an incommensurable amount of money in building a system of ponds on his property which resulted in a financial ruin for his family after Lucullus' death.

Along the variety of fish farmed by the Romans, lamprey and moray eels the most popular across the accommodated class. Fish farming also became a fancy for the very rich citizens with properties at the coast. Ponds from which fresh fish could be directly harvested for the daily meal became a popular feature in Roman villas. Fish farming also has its place in the chronicle of Roman cruelty with tales about the use of lamprey ponds for punishing slaves by throwing them in the ponds or the reference to moray eel skin used as an optimal raw material for lashes.

Beyond tales of business success and failure, Roman writers also paid attention to the production aspects of aquaculture and

the conditions and technical requirements for successful aquaculture. Farm location, pond design, species selection and nutrition were the critical factors identified and discussed by Columella. Following the advice of this writer, a successful investment in fish farming would need to have optimal access to water resources; build ponds of appropriate dimensions allowing continued water renewal; select the correct species according to environmental conditions and acceptance of captivity, and feed the fish with the food of the pertinent composition and characteristics according to the different species. Regarding nutrition, Columella recommended to feed the fish well enough to avoid them being identified as farmed fish in the market which would be accompanied by a corresponding decrease in the price and thus profits. It seems that some sort of consumer's prejudice against farmed fish was already present in Roman times!

Not much information exists on the state of aquaculture production in the Centuries after Columella wrote his treatise, until the fall of Rome in 5th century AD. It is known that carps were introduced from Asia and carp farming in inland waters was undertaken during the Late Empire. Following the fall of Rome most of the industries and knowledge were lost and only preserved in Christian monasteries, from where aquaculture grew again in the Middle Ages.



Mediterranean moray (*Muraena helena*)

© OKYANUS AKVARYUM

NEW STAFF PROFILES



Hao Bin

*Associate Professional Officer,
Aquaculture Branch*

A national of China, Dr Hao holds a B.Sc. in Biology from Harbin Institute of Technology in China, a Ph.D. in Marine Biology from Institute of Oceanology, Chinese Academy of Sciences. During his doctorate period, his study focused on aquatic disease prevention and control, including bacterial pathogenic mechanism, vaccine development & evaluation, as well as prudent use of antibiotics in aquaculture. Then he conducted a four-year post-doctoral research at Institute of Microbiology, Chinese Academy of Sciences. During this period, he mainly studied the antimicrobial resistance (AMR) mechanisms, detection and its effect on biosecurity in aquaculture process. He successfully carried out a project on "the Vertical Migration and Ecological Effects of Tetracycline and Florfenicol in the Sediment of Marine Aquaculture Area", which was funded by the national Natural Science Foundation, in order to explore the migration and ecological effect of antibiotics used in aquaculture.

He recently joined FAO after his assignment as officer in the Division of International Cooperation of Chinese Academy of Fishery Sciences, the national lead scientific research institution of fisheries and aquaculture in China. And more recently, he served as officer in the Department of International Cooperation, the Chinese Ministry of Agriculture and Rural Affairs. He was also responsible for important international cooperation projects, such as "Risk Analysis of Introduction and Extension of Technology and Germplasm for Fishery and Aquaculture in China". He will be working in support of the development and implementation of programs and activities related to the sustainable aquaculture development sector, South-South Cooperation and Aquatic Animal Health.

Hao Bin can be reached at:
Bin.Hao@fao.org



Oluwafemi Ajayi

*Consultant, Aquaculture
Branch*

A national of Nigeria, Oluwafemi joined the FAO Aquaculture Branch in Rome as a consultant in October 2018. Among other things, he will be working on sustainability of nutrition-sensitive integrated agriculture-aquaculture systems, and identification of gaps and needs regarding alternative feed ingredients in aquaculture, including the nutritional composition and quality of major aquatic food. Prior to this role, he was an Intern in the Nutrition and Food Systems Division of FAO where he worked on nutrition education and food loss reduction strategies.

Before he joined FAO, he worked with the WorldFish Center on the nutritional role of small indigenous fish species on the dietary diversity of communities around Lake Bangweulu, Zambia. Based on his work in Zambia with the WorldFish Center, he was selected to be a part of the 2017 Next Generation Delegate of the Chicago Council on Global Affairs' to the Global Food Security Summit. He is also affiliated to the Barilla Center for Food and Nutrition as an Alumnus of the Young Earth Solutions to foster sustainable solutions to global nutritional issues, especially the triple burden of malnutrition.

Oluwafemi holds a Bachelor degree in Food Science and Technology from the Federal University of Agriculture Abeokuta, an MSc in Food Technology from the University of Ibadan, both in Nigeria. He attended a training module on Experimental Aquaculture at the Thunen Institute of Fisheries Ecology, Arhensburg, Germany and obtained his second MSc degree in Organic Agriculture and Food Systems with specializations in Global Nutrition and Social Conditions of Food Systems from the University of Hohenheim, Germany.

Oluwafemi can be reached at:
Oluwafemi.Ajayi@fao.org



Roxane Misk

Intern, Aquaculture Branch

Roxane, a Belgian and Lebanese National, has recently joined the FAO in Rome for a 7-month internship. Roxane holds a Bachelor in Political Sciences and a double Master in International Relations and Global Studies from "Université Libre de Bruxelles", Belgium and LUISS Guido Carli, Rome, Italy. Roxane is interested in Gender Studies and Environment, and during her studies, she analyzed security issues, armed conflicts and globalization before writing her thesis on the construction and the deconstruction of the concept of Gender by Pope Francis on the International scene. She would like to improve her knowledge on fisheries and rice fish farming, but also her communication skills developed in various ways during university, including the management of the photography and fundraising for the Law Faculty Association in ULB, helping with the organization of charity events for cancer and working debate tables.

During her term at FAO, Roxane will focus on the report of gender dimension within the social impact of aquaculture and contributing to ensure the gender dimension in aquaculture development.

Roxane can be reached at:
Roxane.Misk@fao.org



Women collecting larvae of common carp in Kyrgyzstan



Svetlana Velmeskina

Office Assistant, Aquaculture Branch

Svetlana, a Russian national, has recently joined the Aquaculture Branch of the Fisheries and Aquaculture Department as Temporary Office Assistant. Svetlana studied Accounting and Economics; Hospitality and Tourism Management in Russia. She spent first years of her career in tourism related fields as incoming/outgoing visa assistance, letters of invitations, work permits, etc. Svetlana moved to Thailand in 2011, where she worked as Accompanying Assistant at the tour operating company.

She joined FAO in April 2016 as Temporary Assistant at the Plant Production and Protection Division, providing administrative and secretarial support. In 2018, she was assigned for six months to the Secretariat of the Rotterdam Convention with main emphasis of organizational arrangements for the 14th Chemical Review Committee (CRC) and the 14th Persistent Organic Pollutants Review Committee (POPRC).

Svetlana can be reached at:
Svetlana.Velmeskina@fao.org



Valerio Crespi

Fisheries and Aquaculture Officer, Aquaculture Branch

Valerio, Aquaculture Officer of FAO Aquaculture Branch, will bring his extensive knowledge to North Africa. As of December 2018 he will be based in Tunis, Tunisia in the FAO sub-regional office for North Africa. He will assume the new position of *Fisheries and Aquaculture Officer* covering FAO Member countries in North Africa namely Libya, Tunisia, Algeria Morocco and Mauritania. His international experience will contribute to further strengthening fisheries and aquaculture sectors in the sub-region. Clearly, Valerio will be an asset and a key member of FAO sub-regional multidisciplinary team to help implementing the goals of the Organization. We wish him every success in his new position.

Valerio can be reached at:
Valerio.Crespi@fao.org



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Visiting an aquaponics farm in Oman

NEW PUBLICATIONS

NEW PUBLICATIONS • NEW PUBLICATIONS • NEW PUBLICATIONS • NEW PUBLICATIONS • NEW PUBLICATIONS



FAO. 2018 The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals

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The 2018 edition of The State of World Fisheries and Aquaculture emphasizes the sector's role in achieving the 2030 Agenda for Sustainable Development and the Sustainable Development Goals, and measurement of progress towards these goals. It notes the particular contributions of inland and small-scale fisheries, and highlights the importance of rights-based governance for equitable and inclusive development. As in past editions, the publication begins with a global analysis of trends in fisheries and aquaculture production, stocks, processing and use, trade and consumption, based on the latest official statistics, along with a review of the status of the world's fishing fleets and human engagement and governance in the sector. Topics explored in Parts 2 to 4 include aquatic biodiversity; the ecosystem approach to fisheries and to aquaculture; climate change impacts and responses; the sector's contribution to food security and human nutrition; and issues related to international trade, consumer protection and sustainable value chains. Global developments in combating illegal, unreported and unregulated fishing, selected ocean pollution concerns and FAO's efforts to improve capture fishery data are also discussed. The issue concludes with the outlook for the sector, including projections to 2030. As always, The State of World Fisheries and Aquaculture aims to provide objective, reliable and up-to-date information to a wide audience, including policy-makers, managers, scientists, stakeholders and indeed all those interested in the fisheries and aquaculture sector.

The PDF version of this publication can be downloaded at the following web link:

www.fao.org/3/i9540en/i9540EN.pdf

For further information, please contact: Manuel.Barange@fao.org



Handling farmed common carp (*Cyprinus carpio*) in Belarus



FAO. 2018

Impacts of Climate Change on fisheries and aquaculture - Synthesis of current knowledge, adaptation and mitigation options

Barange, M., Bahri, T., Beveridge, M., Cochrane, K., Funge-Smith, S., Poulain, F. (Eds.) 2018. Fisheries and Aquaculture Technical Paper. No. 627. Rome, FAO. 628 pp.

For the first time ever, a publication synthesizes the impacts and risks of, and the opportunities and responses to climate change in the fisheries and aquaculture sector, in the context of poverty alleviation, aimed primarily at policymakers, fisheries managers and practitioners. The technical paper provides the most up-to-date synthesis on the impacts and risks of, and the opportunities and responses to climate change in the fisheries and aquaculture sector, in the context of poverty alleviation. It has been prepared by over 90 scientists from over 20 countries with a view to assisting countries in the development of their National Determined Contributions (NDCs) to the Paris Climate Agreement, the next round of which is to be submitted by 2020, both for adaptation and mitigation actions. The technical Paper covers marine capture fisheries and their environments (Chapters 4 to 17), inland waters and their fisheries (Chapters 18, 19 and 26), as well as aquaculture (Chapters 20 to 22). The Technical Paper also includes chapters on disasters and extreme events (Chapter 23) and health and food safety hazards (Chapter 24). Guidance and tools are presented for planning and implementing effective and explicit adaptation (Chapter 25), while taking into consideration the impacts on fisheries and aquaculture of potential adaptations to climate change in other sectors (Chapter 26). Mitigation is addressed in Chapter 27, which provides quantitative information on the fisheries and aquaculture sector's contributions to greenhouse gas emissions, as well as strategies and tools for mitigation.

The PDF version of this publication can be downloaded at the following web link:

www.fao.org/3/I9705EN/i9705en.pdf

A shorter version is also available at the following web link:

www.fao.org/3/CA0356EN/ca0356en.pdf

For further information, please contact: Manuel.Barange@fao.org



FAO. 2018

Contract farming and public-private partnerships in aquaculture: Lessons learned from East African countries

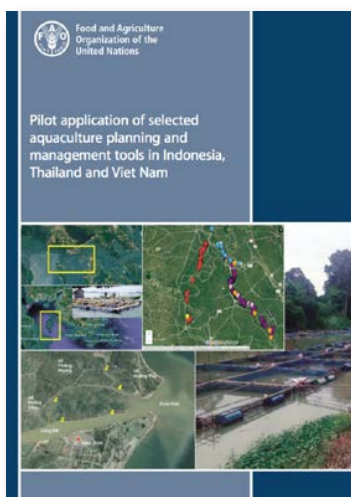
Murekezi, P., Menezes, A., & Ridler, N. 2018. FAO Fisheries and Aquaculture Technical Paper No. 623. Rome, FAO.

Securing decent work for young people in Africa is critical given the large numbers of young people entering the labour force each year (about 11 million). With few opportunities for formal employment in manufacturing and services, agribusinesses offer young people the opportunity to earn income in rural areas. If others emulate them, there is the potential for positive regional spillovers. One institutional innovation that enables young people to mitigate financial and knowledge handicaps is contract farming. By supplying their produce to a third party (such as an agri-processor or retail outlet), which in return guarantees markets and often inputs, young workers are able to access credit, markets and technology. This can be a "win-win" solution because young workers gain access to markets, while the private company has access to produce without having to either acquire land or supervise labour. Fiscally constrained governments also benefit because private sector involvement obviates expenditure and reduces risks, and may also provide expertise unavailable in the public sector. This report presents the lessons learned from a project in four East African countries - Burundi, Kenya, Rwanda and Uganda - focusing on youth and their agribusinesses. In Burundi and Rwanda, poultry and eggs were sold to retailers but were also provided to schools to alleviate malnutrition. In Kenya and Uganda the focus was on fish farming, raising finfish in cages and selling fingerlings. Partnering with private companies enabled young people to obtain business and technical knowledge in addition to a market for their produce.

The PDF version of this publication can be downloaded at the following web link:

www.fao.org/3/CA0134EN/ca0134en.pdf

For further information, please contact: Ana.Menezes@fao.org



FAO. 2018

Pilot application of selected aquaculture planning and management tools in Indonesia, Thailand and Viet Nam

FAO Regional Office for Asia and the Pacific. Bangkok, Thailand. 121 pp.

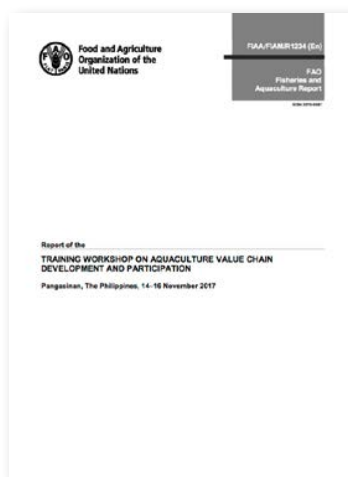
In order to support the member countries in the Asian region to achieve sustainable growth of aquaculture through improved planning and management, FAO Regional Office for Asia and the Pacific implemented a regional TCP project "Pilot application of aquaculture planning and management tools for sustainable growth in selected Southeast Asian countries" from May 2016 to December 2017. The regional TCP project was implemented in three selected ASEAN member countries, namely Indonesia, Thailand and Viet Nam, which covered a range of project activities at regional and country level. The project focused on the development of technical manuals for the aquaculture planning and management tools prioritized by the participating countries, awareness raising and technical capacity building for application of the aquaculture planning and management tools, pilot application of four selected aquaculture planning and management tools in the project participating countries and sharing of the project results for scaling up. This document is an important product of the project implementation and consists of three components: a summary report on the overall implementation of the project at regional and country level; the individual summary report on implementation of project activities in the three participating countries; and technical manuals of four prioritized aquaculture planning and management tools.

The PDF version of this publication can be downloaded at the following web link:

www.fao.org/3/CA1398EN/ca1398en.pdf

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WORKSHOP PROCEEDINGS AND REPORTS



FAO. 2018

Report of the training workshop on aquaculture value chain development and participation, Pangasinan, the Philippines, 14-16 November 2017

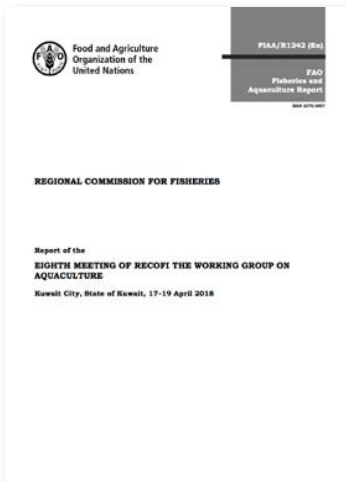
FAO Fisheries and Aquaculture Report No. 1234. Rome, Italy

This training workshop aimed to improve the entrepreneurial capacity of participants – organized smallscale aquaculture producers – to develop a market for their products, integrate their enterprise in the value chain, and participate effectively in the value chain. The main participants were the members of a women's association established in 1989 called the Binmaley Rural Improvement Club (BRIC). They are farming milkfish and processing and marketing milkfish-based product forms. The other participants are farmers who are not members of the association, officers of the village in which the association is based, one government officer each from Indonesia and Viet Nam, and technical officers of the Bureau of Fisheries and Aquatic Resources (BFAR). Five learning modules and a case study of BRIC in a value chain context were prepared for the training. The conclusions from the workshop are as follows. First, it is essential for small farmers to be organized and trained in both technical and management aspects for effective participation in the value chain. Second, a resilient value chain makes small-scale producers resilient to risks. Third, an organized women's group can play a very important role in the value chain especially in creating and accessing markets. Fourth, women participation in the aquaculture value chain promotes the broader goal of gender equality.

The PDF version of this publication can be downloaded at the following web link:

www.fao.org/3/I9600EN/i9600en.pdf

For further information, please contact: Tipparat.Pongthanapanich@fao.org



FAO. 2018

Report of the Eighth Meeting of the RECOFI Working Group on Aquaculture, Kuwait City, State of Kuwait, 17-19 April 2018

FAO Fisheries and Aquaculture Report No. 1242. Rome

The eighth meeting of the Working Group on Aquaculture (WGA) of the Regional Commission for Fisheries (RECOFI) was held in Kuwait City, State of Kuwait, from 17 to 19 April. The WGA reviewed the outcome and recommendations of the eighth session of the Commission, ninth session of COFI Sub-Committee on Aquaculture; and thirty-third session of the FAO Regional Conference for the Near East. The WGA noted that a major intersessional activity was the Regional Workshop on Building National Capacity for Cultured Animal Disease Diagnostic in Relation to Bio-Security. It was highlighted that the workshop, which was originally scheduled to be held in Saudi Arabia, was held in Cairo, Egypt, from 6 to 8 March 2018, for organizational reasons. A brief status review of aquaculture developments in participating member countries was done. Among the main priorities identified for the region, the WGA agreed on the importance of: (i) sharing work experiences on aquaculture spatial planning and discuss criteria and indicators to be used for fish cage culture site selection; (ii) adopting the proposed FAO-FIAS roadmap for the implementation of RECOFI recommendations on minimum data reporting on aquaculture; and (iii) revising and update the contents of the Regional Aquaculture Information System (RAIS). The WGA agreed on a programme of work for the intersessional period 2018-2020.

The PDF version of this publication can be downloaded at the following web link:

www.fao.org/3/CA1351EN/ca1351en.pdf

For further information, please contact: Haydar.Fersoy@fao.org



FAO. 2018

Report of the Thirty-fifth Session of the Asia-Pacific Fishery Commission, Cebu, the Philippines, 11-13 May 2018

Bangkok. 124 pp. Licence: CC BY-NC-SA 3.0 IGO.

This document is the report of the Thirty-fifth Session of the Asia-Pacific Fishery Commission (APFIC) convened in Cebu, the Philippines from 11 to 13 May 2018. The report summarizes convene of each session agenda, major interventions from members and observers and the decision of the Commission. The Session included the following agenda items: (1) Secretariat report on intersessional programme activities of APFIC; (2) the report of the meeting of the Seventy-sixth APFIC Executive Committee; (3) Report and the recommendations of the Seventh Regional Consultative Forum Meeting; (4) report and the recommendations of the APFIC 'Regional Consultation to Promote Responsible Production and Use of Feed and Feed Ingredients for Sustainable Growth of Aquaculture in Asia-Pacific (7 to 9 March 2017 in Bangkok, Thailand)'; (5) report on and the recommended strategies stemming from the APFIC 'Regional Consultation on Building Climate Resilient Fisheries and Aquaculture in the Asia-Pacific Region (14 to 16 November 2017 in Bangkok, Thailand)'; (6) report on implementation of the FAO Regional Initiative on Blue Growth in Asia-Pacific and the new programmatic framework and implementation plan for 2018 to 2019; (7) report on APFIC's work supporting combating illegal, unreported and unregulated (IUU) fishing in the region; (8) report introducing Official Development Assistance (ODA) and of the regional and country Global Environment Facility (GEF) projects as funding opportunities for fishery management and capacity in the region; and (9) draft 2018-2023 APFIC strategic plan and the 2018-2019 biennial work plan of the APFIC.

The PDF version of this publication can be downloaded at the following web link:

www.fao.org/3/CA1701EN/ca1701en.pdf

For further information, please contact: Weimin.Miao@fao.org



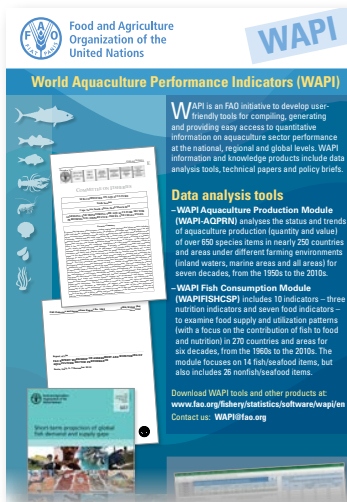
FAO. 2018
Zonificación acuícola, selección de sitios y áreas de manejo bajo el enfoque ecosistémico a la acuicultura. Un manual. Informe ACS18071
 Aguilar-Manjarrez, J., Soto, D. y Brummett, R. 2018. Roma, FAO y el Grupo del Banco Mundial, Washington DC. 62 pp. Incluye una tarjeta USB que contiene el documento completo (395 pp.).

El enfoque ecosistémico a la acuicultura provee lineamientos conceptuales para la planeación espacial y el manejo. Esta publicación describe los pasos principales a seguir en estas actividades. El razonamiento y objetivos de cada paso, las maneras (métodos) para implementarlo y los medios (herramientas) disponibles para aplicar una metodología se describen a modo de etapas. Se proveen recomendaciones para implementadores y tomadores de decisiones. Un documento de políticas acompaña a esta publicación. Existen numerosos beneficios de la planeación y manejo espacial, entre los que se incluyen una mayor productividad y retornos para los inversionistas, así como una mitigación más efectiva de los riesgos ambientales, económicos y sociales; los detalles se incluyen en este documento.

The PDF version of this publication can be downloaded at the following web link:

www.fao.org/3/I6834ES/I6834es.pdf

For further information, please contact: Jose.AguilarManjarrez@fao.org



FAO. 2018
The World Aquaculture Performance Indicators (WAPI) Aquaculture Production Module (WAPI-AQPRN v.2018.1)

The aquaculture production module analyses the status and trends (1950-2016) of aquaculture production (quantity and value) of over 650 species items in nearly 250 countries and areas under different farming environments (inland waters, marine areas and all areas).

The MS-Excel version of this publication can be downloaded at the following web link:

[www.fao.org/fishery/static/WAPI/FAOWAPIAquacultureProductionModule\(WAPI-AQPRNv.2018.1\).zip](http://www.fao.org/fishery/static/WAPI/FAOWAPIAquacultureProductionModule(WAPI-AQPRNv.2018.1).zip)

For further information, please contact: Junning.Cai@fao.org



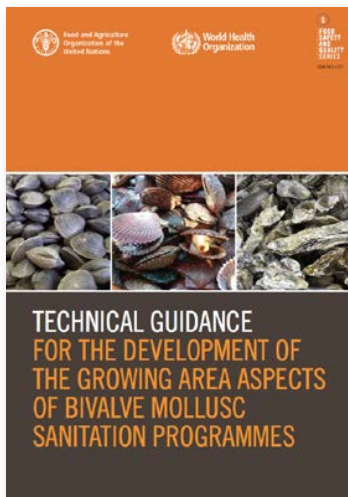
FAO. 2018
The World Aquaculture Performance Indicators (WAPI) Fish Consumption Module (WAPIFISHCSP v.2018.1)

The fish consumption module includes 10 indicators – three nutrition indicators and seven food indicators - to examine food supply and utilization patterns (with a focus on the contribution of fish to food and nutrition) in 270 countries and areas for six decades, from the 1960s to the 2010s. The module focuses on 14 fish/seafood items, but also includes 26 non-fish/seafood items.

The PDF version of this publication can be downloaded at the following web link:

[www.fao.org/fishery/static/WAPI/FAOWAPIFishConsumptionModule\(WAPI-FISHCSPv.2018.1\).zip](http://www.fao.org/fishery/static/WAPI/FAOWAPIFishConsumptionModule(WAPI-FISHCSPv.2018.1).zip)

For further information, please contact: Junning.Cai@fao.org



FAO and WHO 2018

Technical guidance for the development of the growing area aspects of Bivalve Mollusc Sanitation Programmes

Food Safety and Quality Series No. 5 Rome. 292 pp.

International trade has been the main driving factor for the rapid growth of the bivalve mollusc production industry during the last six decades, growing from nearly one million tonnes in 1950 to 16.1 million tonnes in 2015. In recognition of the extensive trade of this commodity the Codex Alimentarius Commission has developed a Standard for Live and Raw Bivalve Molluscs as well as guidance in the Codex Code of Practice for Fish and Fishery Products on the steps needed to be taken at all stages of food chain in order to produce a product that meets the Codex Standard. However, to facilitate implementation of the Codex guidance, countries identified the need for more information on how to implement Codex guidance in their specific context and specifically how to establish and monitor a bivalve mollusc growing area. This FAO/WHO Technical Guidance for the Development of the Growing Area Aspects of Bivalve Mollusc Sanitation Programmes aims to address that need. The focus of the guidance is the primary production of molluscs for consumption as live or raw bivalves and in particular how to manage microbiological hazards at this stage. The guidance is primarily aimed at the authorities responsible for the development, implementation and application of a bivalve mollusc sanitation programme, while highlighting the collaboration and agreements required between different partners including local authorities, regulatory agencies and laboratories to implement such a programme.

The PDF version of this publication can be downloaded at the following web link:

www.fao.org/3/CA1213EN/ca1213en.pdf

For further information, please contact: Esther.GarridoGamarro@fao.org



FAO 2018

Guidance on spatial technologies for disaster risk management in aquaculture. Full document. Rome, FAO.

Licence: CC BY-NC-SA 3.0 IGO.

Aguilar-Manjarrez, J., Wickliffe, L.C. & Dean, A., eds. 2018.

This new guide describes the application of spatial technology to improve disaster risk management (DRM) within the aquaculture sector. DRM requires interrelated actions and activities to ensure early warning, prevention, preparedness, response and recovery for a wide range of natural, technological and complex disasters that can impact aquaculture operations and livelihoods. Spatial technology refers to systems and tools that acquire, manage and analyse data that have geographic context. Some of the technologies include satellite remote sensing, aerial surveys, global positioning systems, geographic information systems, information and communication technology and other data gathering sensors used, for instance, in meteorology. Spatial technology supports activities across all phases of the DRM cycle and its rapid development provides enhanced opportunities to support DRM within the aquaculture sector. This guide is organized in two parts. Part one is the "guidance"; it is the main body of the document and describes the processes and steps for the use of spatial technology within DRM for aquaculture. Part two includes selected country case studies from Bangladesh, the Gulf of Mexico and the Caribbean, and Indonesia to illustrate the application of spatial technology in DRM for aquaculture at the national level within local contexts. Best practices at the farm and area management levels, supported by spatial technology, reduce volatility and risks and thus facilitate investment. Countries that would like aquaculture to grow sustainably and reliably are encouraged to use this guide in order to support spatial planning approaches and protect responsible investors. A separate summary version accompanies this publication.

The PDF version of this publication will be available in the FAO Web site soon.

For further information, please contact: Jose.AguilarManjarrez@fao.org

CALENDAR OF EVENTS

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- SEPT 2018**
- Fourth Forum of Parliamentarians of Fisheries and Aquaculture of Latin America and the Caribbean**
Panamá City, Panama, 19-20 September – Information: Alejandro.Flores@fao.org
- Consultative meeting on regional level strategy model for decent youth employment in aquaculture and related value chains**
Bissau, Guinea Bissau, 26-30 September 2018 - Information: Ana.Menezes@fao.org
- GFCM expert consultation on a methodology for market studies on aquaculture**
GFCM headquarters, Rome, Italy, 27-28 September 2018 – Information: Fabio.Massa@fao.org
- Effective Fish Trade and Sustainable Development - Caribbean Regional Workshop for Small Island Developing States**
Bridgetown, Barbados, 3-5 October 2018 – Information: John.Ryder@fao.org
- GFCM regional workshop on aquaculture governance and regulatory issues.**
Larnaca, Cyprus, 2-3 October 2018 – Information: Fabio.Massa@fao.org
- INCEPTION WORKSHOP OF THE TECHNICAL COOPERATION PROGRAMME TITLED: "Blue Hope Initiative in the Mediterranean Sea"**
*Monastir, Tunisia, 3-5 October 2018. The project involves three countries: Turkey, Tunisia and Algeria
Information: Henry.DeBey@fao.org*
- OCT 2018**
- GFCM workshop on animal health and risk analysis in finfish aquaculture**
Larnaca, Cyprus, 3-4 October 2018 – Information: Fabio.Massa@fao.org
- Workshop on Aquaculture Statistics Data Collection, Reporting and Dissemination in the East African Region**
Jinja, Uganda, 8-12 October 2018 – Information: Xiaowei.Zhou@fao.org
- Training workshop on white shrimp value chain development and participation**
Ben Tre, Viet Nam 15-17 October 2018 – Information: Tipparat.Pongthanapanich@fao.org
- Sixth Session of the Central Asian and Caucasus Regional Fisheries and Aquaculture Commission (CACFish)**
Izmir, Turkey, 15-18 October 2018 – Information: CACFish-Secretariat@fao.org
- NOV 2018**
- International Seminar on Sustainable Seafood Value Chain: Traceability**
Shanghai, China 28-30 November – Information: John.Ryder@fao.org
- DEC 2018**
- Consultative Regional (sub-Saharan) meeting on improving policy development in aquaculture in support of food security and nutrition, poverty alleviation and sustainable development.**
Addis Ababa, Ethiopia, 3-5 December 2018 – Information: Ana.Menezes@fao.org
- NON FAO EVENTS**
- OCT 2018**
- International Congress on World Fisheries Production, and International Frozen Seafood Exhibition (CONXEMAR).**
Vigo, Spain, 1-4 October 2018 - www.conxemar.com – Information: Audun.Lem@fao.org
- NOV 2018**
- Sustainable Blue Economy Conference**
Nairobi, Kenya, 26-28 November 2018 - www.blueeconomyconference.go.ke – Information: Ana.Menezes@fao.org



FAO Fisheries and Aquaculture Statistical Collections

FAO represents the only global source of fisheries and aquaculture statistics, covering production (by capture and aquaculture), trade, employment, fleet and food balance sheets. These data are stored into different statistical collections available through various formats, tools and information products. Currently 2016 represents the latest year available for these statistics (except food balance sheets up to 2013) and work is in progress to update them up to 2017 for the release in March 2019.



FishStatJ - Software for fishery statistical time series

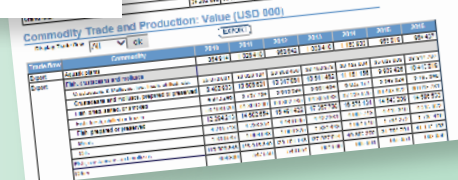
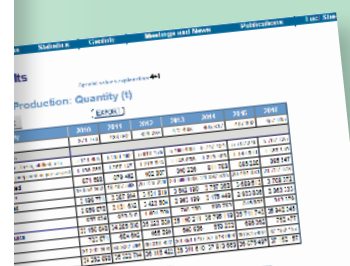
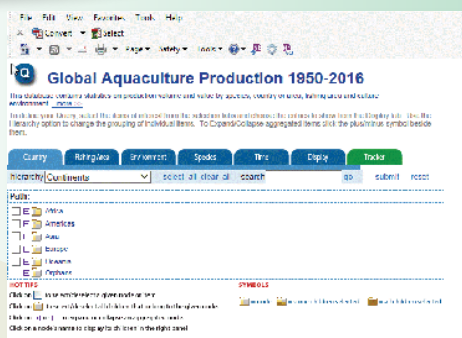
A Java-based desktop application for complex and sophisticated data exploration and extraction. It consists of a main application and several workspaces with data on global and regional statistics.

FAO Yearbook of Fishery and Aquaculture Statistics

provides a full range of tables with detailed statistics. It is structured into a **booklet** (containing summary tables, notes on major trends, concepts, classifications and a map of FAO major fishing areas) and a **USB Card** presenting the full yearbook package with all the key information and the complete set of statistical tables.



Online Query Panels enable advanced users to extract customized information and reports.



FAN

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