

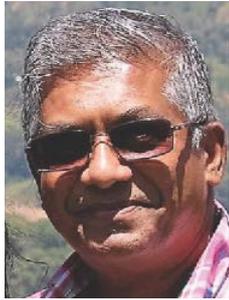
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FAO Aquaculture Newsletter



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R. SUBASINGHE



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Woman feeding fish to her child in Bangladesh

Nutrition Sensitive Aquaculture: a Dream or a Reality?

Fish provides more than 4.5 billion people with at least 15 percent of their average per capita intake of animal protein. Fish's unique nutritional properties make it also essential to the health of billions of consumers in both developed and developing countries. Fish is one of the most efficient converters of feed into high quality food and its carbon footprint is lower compared to other animal production systems. Considering the increasing global population and importance of feeding the future world with a healthy and nutritious diet, many have stressed that fish should be on everyone's plate.

Fish is more than just a source of animal protein. It contains several essential amino acids, especially lysine and methionine. The lipid composition of fish, with the presence of long-chain, poly-unsaturated fatty acids (LC-PUFAs), is unique. Fish is also an important source of essential micronutrients – vitamins D, A and B, and minerals (calcium, phosphorus, iodine, zinc, iron and selenium), which makes it particularly attractive in the current fight against malnutrition in low income and food deficient countries (LIFDCs). Consumption of fish and especially oily fish is essential for an optimal development of the brain and neural system of our children, since omega-3 fatty acids in the

form of DHA (docosahexaenoic acid) rather than ALA (α -Linolenic acid) is needed to secure an optimal brain development. This is particularly important during pregnancy and the first two years of life (the 1000-day window).

Considering the past trends and experience in global fish production, it is likely that the future demand for fish would be met by aquaculture and the global per capita fish consumption may increase from current 21 kg to at least 23 kg per year by 2025. However, there are a few ethical issues.

Some claim that, due to the high commodity value, there is a trend towards increasing production of shrimp in Asia (Asia contributes nearly 90 percent to the global aquaculture production). They argue that considering the increasing cost of fishmeal, which is a main ingredient for shrimp feed, there is also a trend in sourcing fishmeal locally using small local species, that would otherwise have been consumed directly by humans. Small indigenous fish species, which could be eaten whole and which are very high in micronutrients such as vitamin A and B12, should not be used for making fishmeal but be promoted as food and their production should be increased, where appropriate.

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A trade-off exists between export value and local nutrition. In several countries in Asia, particularly in Bangladesh and India, efforts are being made to improve household fish consumption through increase traditional homestead fish production. These efforts are providing convincing results and the interventions and principles are now proving successful and adaptable and/or repeatable in other countries.

A recent study¹ focussing 41 nutritionally vulnerable nations (NVN), tried to find whether aquaculture meets human nutritional demand directly via domestic production or trade, or indirectly via purchase of nutritionally rich dietary substitutes. The study revealed that only a limited number of NVNs have domestically farmed fish, and of those, only specific aquaculture approaches (e.g. freshwater) in some locations have the potential to benefit nutritionally vulnerable populations. In other words, high value farmed fish always find a market outside the location of production.

It has also been found, in some parts of Bangladesh, increased availability of cultured freshwater fish has increased consumption of fish in rural households, although consumption of traditional small indigenous species with superior nutritional qualities has been reduced significantly. This is an

1 Golden, C.D., Seto, K.L., Dey, M.M., Chen, O.L., Gephart, J.A., Myers, S.S., Smith, M., Vaitla, B. & Allison, E.H. 2017. **Does Aquaculture Support the Needs of Nutritionally Vulnerable Nations?** *Front. Mar. Sci.* 4:159. doi: 10.3389/fmars.2017.00159



Bangladeshi woman showing small indigenous species, mola (*Amblypharyngodon mola*) cultured in her backyard pond

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alarming situation, especially when promoting fish as a nutritious alternative to less healthier diets in the world².

These observations left should be pushing us rethink and redesign our strategies towards aquaculture development worldwide. Is the notion of nutrition sensitive aquaculture, a dream or reality? Thinking positively with some experiences from several NVNs,

2 Citation: Bogard JR, Farook S, Marks GC, Waid J, Belton B, Ali M, et al. (2017) **Higher fish but lower micronutrient intakes: Temporal changes in fish consumption from capture fisheries and aquaculture in Bangladesh.** *PLoS ONE* 12(4): e0175098. <https://doi.org/10.1371/journal.pone.0175098>

I truly believe nutrition sensitive aquaculture can become a reality, if we make a paradigm shift in thinking from “aquaculture development” to “aquaculture for sustainable development”, using fish as the entry point to improve nutrition and livelihoods of target communities consisting billions of people worldwide. We need the political will!

Rohana Subasinghe
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Woman selling smoked North African catfish outside Albert Market in Banjul, Gambia

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Freshwater prawns (*Macrobrachium rosenbergii*) are selling on a street market in Bangladesh

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American bullfrogs are intensively grown in an aquaculture facility in Hong He County, China PR

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Seaweed farmers carrying seaweed seedlings, Indonesia

COFI Sub-Committee on Aquaculture

Ninth Session

Rome, Italy

24-27 October 2017

The FAO Committee on Fisheries (COFI), Sub-Committee on Aquaculture (SCA) provides a forum for consultation and discussion on aquaculture and advises COFI on technical and policy matters related to aquaculture and on the work to be performed by FAO in the subject matter field of aquaculture.

The First session of the COFI-SCA took place in Beijing, China P.R. in 2002. The meeting, held every two years, in different countries, is open to all Member Nations of the Organization.

Non-Member states of the Organization that are members of the United Nations, or any of its Specialized Agencies or the International Atomic Energy Agency, may be admitted by the Council of the Organization to membership in the Sub-Committee.

The Ninth session runs from 24–27 October 2017 and will take place at FAO, Rome. Delegations from FAO Member States, UN Specialized Agencies and Related Organizations, and Intergovernmental organizations/Non-governmental organizations, have been invited to attend this session of COFI-SCA.

The full agenda along with supporting documents can be found at:

www.fao.org/cofi/aq/en

The week dedicated to aquaculture envisions a full agenda of discussions and decision on various topics of interest, including:

- FAO Fisheries and Aquaculture Department's efforts in Implementing the Recommendations



Eighth Session of COFI-SCA, Brasilia, Brazil 5-9 October 2015

of the past sessions of the COFI Sub-Committee on Aquaculture;

- Progress Reporting on the Implementation of the Code of Conduct for Responsible Fisheries (CCRF) provisions relevant to Aquaculture and Culture-based Fisheries;
- Report from the Secretariat of the COFI Sub-committee on Fish Trade;
- The sustainable development goals (SDGs)/ Agenda 2030 and FAO'S common vision for sustainable food and agriculture
- Extension for Aquaculture Development;
- Special event on aquaculture in the Small Island Developing States (SIDS): blue growth opportunities for SIDS in a changing climate;
- Progress reporting on the implementation of the technical guidelines on aquaculture certification and the evaluation framework to assess conformity of aquaculture.

Although every session of COFI-SCA raises new issues and areas of work, we're particularly excited about some new items on the agenda this year, for example, for the first time ever we will have a dedicated event on aquaculture in the Small Island Developing States.

If you're not with us in Rome for COFI-SCA this year, follow our wrap-ups in our Blue Growth blog posts, or follow our live tweeting from @FAOfish or through the hashtag #COFlaquaculture.

For further information, please contact: Matthias.Halwart@fao.org



FAO Secretariat preparing the Ninth Session of COFI-SCA



SEE ALSO

<http://www.fao.org/fishery/nems/40786/en>
www.youtube.com/watch?v=S9gEWXLOfio

GLOBAL AQUACULTURE UPDATES

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Considerations from the Aquaculture Statistician

World aquaculture production statistics for 2016 are under preparation

The volume and value data in the FAO global aquaculture production database are primarily official statistics directly provided by FAO Member countries through an annual collection. By the official deadline (31 August 2017), only about 50 countries had provided aquaculture production data up to 2016. Therefore, during the next few months FAO will need to regularly interact with countries in order to obtain these data and expand the coverage and the quality of official statistics included in the database. The complete 2016 statistics will be officially released in mid-March 2018. They will be also used as a basis to describe recent status and trend analysis in the 2018 edition of the flagship publication



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of the Fisheries and Aquaculture Department: the State of the World Fisheries and Aquaculture (SOFIA) expected to be released in July 2018.

Data received so far, along with the information collected from the late reporting countries, especially major aquaculture producers, point to a further increase of world aquaculture production in 2016 up to a record of 80 million tonnes (excluding aquatic plants).

Red swamp crayfish has become an aquaculture superstar in China

In June 2017, the Chinese fisheries authority released

the National Crayfish Industry Development Report (only available in Chinese). According to it, the red swamp crayfish (*Procambarus clarkii*), introduced into the country in the 1930s, became the most farmed crustacean species in freshwater aquaculture in China in 2016 (Figure 1). The total production of crayfish reached 899 100 tonnes in 2016, of which 95 percent (852 300 tonnes) from aquaculture. The annual production has more than tripled in the past decade, which makes China the world's largest crayfish producer in 2016.

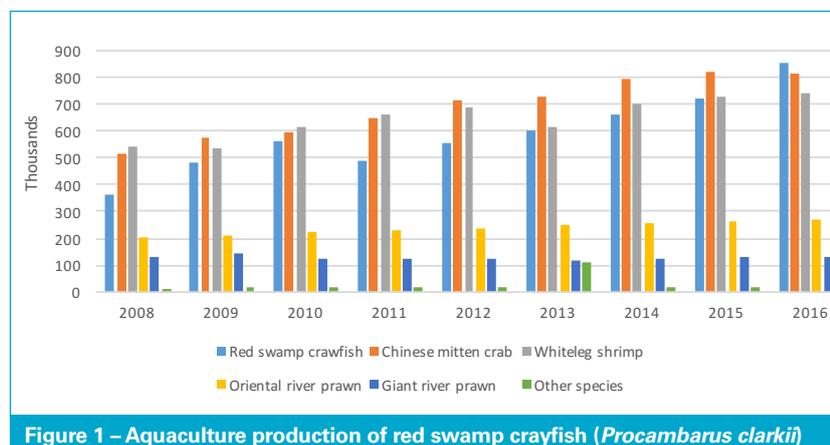


Figure 1 – Aquaculture production of red swamp crayfish (*Procambarus clarkii*)

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Red swamp crawfish (*Procambarus clarkii*)

The species plays an important role in terms of economic and employment generator. The total economic value of the crawfish industry reached USD 23.6 billion in 2016, including USD 9.1 billion in first sale, USD 1.6 billion in processing and USD 12.9 billion in marketing and it has created full time or part time jobs for five million people in 2016. The crawfish farm gate value was more important than the total market value of the fast growing IT cloud computing market value in the same year in the country.

Use of aquaculture ponds for renewable clean energy production

The date of 30 December 2011 marks the start of development of solar photovoltaic system above aquaculture water bodies in China. On that day, a 20 megawatt photovoltaic system with solar panels was installed above the surface of 45 ha of fish ponds in Jianhu County, Jiangsu Province, China. By the end of 2016 there were at least over 60 solar power plants built on the top of aquaculture ponds in 14 Chinese provinces. The largest project has the capacity of 200 megawatt with solar panels above the surface area of about 300 ha of fish ponds in Zhejiang Province. Most projects have solar panels installed on frames supported by

concrete piles rooted in the fish pond bottom. Only few projects have solar panels mounted on

floating structures in small lakes, which does not represent an easy/practical solution for aquaculture operations.



SEE ALSO

FAO. 2016. *The State of World Fisheries and Aquaculture 2016. Contributing to food security and nutrition for all*. Rome, Italy. 200 pp. www.fao.org/3/a-i5555e.pdf

FAO Cultured Species Fact Sheet on red swamp crawfish (*Procambarus clarkii*) www.fao.org/fishery/culturedspecies/Procambarus_clarkii/en



©COURTESY OF Z. WEI

One of the coastal aquaculture ponds with solar panels for clean power generation in Rudong County, Jiangsu Province, China. Wind turbines seen in the background include those installed in the shallow sea surrounded by aquaculture production of edible seaweed *Pyropia yezoensis*



©2015 GOOGLE

Google Earth satellite image showing the distributed solar photovoltaic systems with solar panels installed above fish ponds in Jianhu County, Jiangsu Province, China. Measurement of this image, from left to right, is about 2.9 kilometres

Tilapia Lake Virus (TiLV) Caused by an Orthomyxo-like virus (Family Orthomyxoviridae) Threatening Cultured and Wild Stocks of Tilapia

Tilapias are the second-most important cultured finfish worldwide (next to the cyprinids) and farmed globally by many small-holders. Nile tilapia (*Oreochromis niloticus*) ranks 6th among the most important cultured species, providing food, jobs and domestic and export earnings. Tilapia aquaculture production (2015 statistics) was about 5.6 million tonnes. The top 10 tilapia producers for 2015 are: People's Republic of China (1.8 million tonnes), Indonesia (1.1 million tonnes), Egypt (875 thousand tonnes), Bangladesh (324 thousand tonnes), Viet Nam (283 thousand tonnes), Philippines (261 thousand tonnes), Brazil (219 thousand tonnes), Thailand (177 thousand tonnes), Colombia (61 thousand tonnes), and Uganda (57 thousand tonnes)¹. In terms of global tilapia commodity trade and production (export, import, production, reexport), official FAO data for 2013 reported quantity of 1.2 million tonnes and a value of USD 3.7 billion². Tilapias are an important protein source, especially for poor consumers,

1 www.fao.org/fishery/statistics/global-production/en

2 FAO - Fisheries and Aquaculture Information and Statistics Branch



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because they are affordable, have an omnivorous diet, are tolerant to high-density aquaculture, and relatively disease resistant.

Cultured and wild stocks of tilapias are now threatened by an emerging disease caused by Tilapia lake virus (TiLV). In May 2017, FAO³ and several institutions (NACA⁴, OIE⁵, WF⁶) released alerts, disease cards, advisory and fact sheet about TiLV. The purpose of the FAO Global Information and Early Warning System on Food and Agriculture (GIEWS) Special Alert is to be informed of threats to food security and livelihoods, in this case, TiLV that may affect communities that are dependent on tilapia farming. Based on scientific literature, TiLV has been reported in some countries in Asia, Africa and Latin America. It is likely that TiLV may have a wider distribution than is known today. There is a significant risk of TiLV being translocated both inter- and intra-continently through the movement of infected live tilapias in the absence of appropriate biosecurity measures.

3 www.fao.org/3/a-i7326e.pdf

4 <https://enaca.org/enclosure.php?id=864>

5 www.oie.int/fileadmin/Home/eng/International_Standard_Setting/docs/pdf/Aquatic_Commission/A_TiLV_disease_card.pdf

6 http://pubs.iclarm.net/resource_centre/FISH-2017-03.pdf



Upper figure: Red hybrid tilapia (*Oreochromis* spp.) showed clinical signs of TiLV infection including skin redness, skin erosion, multiple hemorrhages on the skin

©WIN SURACHETPONG, KASETSART UNIVERSITY

Causative agent – TiLV is caused by an enveloped, negative-sense, single-stranded RNA virus (belonging to the family Orthomyxoviridae) with 10 segments⁷ and a diameter between 55 and 100 nm⁸.

Affected species – Farmed species (in earthen ponds and floating cages) affected include

7 Eyngor M, Zamostiano R, Kembou Tsofack JE, Berkowitz A, Bercovier H, Tinman S, Lev M, Hurvitz A, Galeotti M, Bacharach E and Eldar A. 2014.

Identification of a novel RNA virus lethal to tilapia. *Journal of Clinical Microbiology* 52:4137–4146; Bacharach E, Mishra N, Briese T, Zody MC, Kembou Tsofack JE, Zamostiano R, Berkowitz A, Ng J, Nitido A, Corvelo A, Toussaint NC, Abel Nielsen SC, Hornig M, Del Pozo J, Bloom T, Ferguson H, Eldar A and Lipkin WI. 2016. **Characterization of a Novel Orthomyxo-like Virus Causing Mass Die-Offs of Tilapia.** *MBio* 7, e00431-16

8 Ferguson HW, Kabuusu R, Beltran S, Reyes E, Lince JA and del Pozo J. 2014.

Syncytial hepatitis of farmed tilapia, *Oreochromis niloticus* (L.): A case report. *Journal of Fish Diseases* 37:583–589; Eyngor M, Zamostiano R, Kembou Tsofack JE, Berkowitz A, Bercovier H, Tinman S, Lev M, Hurvitz A, Galeotti M, Bacharach E and Eldar A. 2014. **Identification of a novel RNA virus lethal to tilapia.** *Journal of Clinical Microbiology* 52:4137–4146; Surachetpong W, Janetanakit T, Nonthabenjawan N, Tattiyapong P, Sirikanchana K and Amonsin A. 2017. **Outbreaks of tilapia lake virus infection, Thailand, 2015–2016.** *Emerging Infectious Diseases.* 23:1031–1033.

hybrid tilapia (*Oreochromis niloticus* x *O. aureus* hybrids)⁹, Nile tilapia (*O. niloticus*)¹⁰ and red tilapia (*Oreochromis* sp.)¹¹; TiLV has also been reported to affect wild *Sarotherodon galileus* (Galilea tilapia). Small- and large-sized fish were reported to be affected. Clinical signs of affected species include lethargy, ocular alterations, skin erosions and discolouration (darkening)¹²; exophthalmia, discoloration (darkening), abdominal distension, scale protrusion and gill pallor¹³; appetite loss, lethargy, abnormal behaviour, pallor, anaemia, exophthalmia, abdominal swelling and skin congestion and erosion

9 Eyngor M, Zamostiano R, Kembou Tsoufack JE, Berkowitz A, Bercovier H, Tinman S, Lev M, Hurvitz A, Galeotti M, Bacharach E and Eldar A. 2014. **Identification of a novel RNA virus lethal to tilapia.** *Journal of Clinical Microbiology* 52:4137–4146.

10 Fathi M, Dickson C, Dickson M, Leschen W, Bailly J, Muir F, Ulrich K and Weidmann M. 2017. **Identification of Tilapia Lake Virus in Egypt in Nile tilapia affected by 'summer mortality' syndrome.** *Aquaculture* 473:430–432;

Ferguson HW, Kabuusu R, Beltran S, Reyes E, Lince JA and del Pozo J. 2014. **Syncytial hepatitis of farmed tilapia, *Oreochromis niloticus* (L.): A case report.** *Journal of Fish Diseases* 37:583–589; Dong HT, Siriroob S, Meemetta W, Santimanawong W, Gangnonngiw W, Pirarat N, Khunrae P, Rattanarojpong T, Vanichviriyakit R and Senapin S. 2017a. **Emergence of tilapia lake virus in Thailand and an alternative semi-nested RT-PCR for detection.** *Aquaculture* 476:111–118.

11 Dong HT, Siriroob S, Meemetta W, Santimanawong W, Gangnonngiw W, Pirarat N, Khunrae P, Rattanarojpong T, Vanichviriyakit R and Senapin S. 2017a. **Emergence of tilapia lake virus in Thailand and an alternative semi-nested RT-PCR for detection.** *Aquaculture* 476:111–118; Surachetpong W, Janetanakit T, Nonthabenjawan N, Tattiyapong P, Sirikanchana K and Amonsin A. 2017. **Outbreaks of tilapia lake virus infection, Thailand, 2015–2016.** *Emerging Infectious Diseases*. 23:1031–1033.

12 Eyngor M, Zamostiano R, Kembou Tsoufack JE, Berkowitz A, Bercovier H, Tinman S, Lev M, Hurvitz A, Galeotti M, Bacharach E and Eldar A. 2014. **Identification of a novel RNA virus lethal to tilapia.** *Journal of Clinical Microbiology* 52:4137–4146.

13 Ferguson HW, Kabuusu R, Beltran S, Reyes E, Lince JA and del Pozo J. 2014. **Syncytial hepatitis of farmed tilapia, *Oreochromis niloticus* (L.): A case report.** *Journal of Fish Diseases* 37:583–589.

has been reported¹⁴. Mortalities were observed within the first month after transfer to grow-out cages¹⁵; high mortalities were observed within two weeks of the onset¹⁶

Environmental factors –

Outbreaks were observed to occur during hot season (at water temperature ranging between 22 °C to 32 °C) during the months between May and November. Thai researchers observed that TiLV occurred following transfer to grow-out cages.

Reported losses – In Israel, the tilapia wild catch (main species: *Sarotherodon galilaeus*) in Lake Kinneret (The Sea of Galilee) dropped significantly from an average level of 257 tonnes per year to 8 tonnes per year in 2008. The drop was linked to TiLV disease. In Thailand, during 2015 and 2016 TiLV outbreaks resulted in mortalities between 20 to 90 percent¹⁷, with records indicating many deaths of farmed Nile tilapia and red tilapia hybrid.

14 Dong, H.T., Siriroob, S., Meemetta, W., Santimanawong, W., Gangnonngiw, W., Pirarat, N., Khunrae, K., Rattanarojpong, T., Vanichviriyakit, R., and Senapin, S. (2017a). **Emergence of tilapia lake virus in Thailand and an alternative semi-nested RT-PCR for detection.** *Aquaculture* 476, 111–118; Surachetpong W, Janetanakit T, Nonthabenjawan N, Tattiyapong P, Sirikanchana K and Amonsin A. 2017. **Outbreaks of tilapia lake virus infection, Thailand, 2015–2016.** *Emerging Infectious Diseases*. 23:1031–1033.

15 Dong, H.T., Siriroob, S., Meemetta, W., Santimanawong, W., Gangnonngiw, W., Pirarat, N., Khunrae, K., Rattanarojpong, T., Vanichviriyakit, R., and Senapin, S. (2017a). **Emergence of tilapia lake virus in Thailand and an alternative semi-nested RT-PCR for detection.** *Aquaculture* 476, 111–118.

16 Surachetpong W, Janetanakit T, Nonthabenjawan N, Tattiyapong P, Sirikanchana K and Amonsin A. 2017. **Outbreaks of tilapia lake virus infection, Thailand, 2015–2016.** *Emerging Infectious Diseases*. 23:1031–1033.

17 Dong, H.T., Siriroob, S., Meemetta, W., Santimanawong, W., Gangnonngiw, W., Pirarat, N., Khunrae, K., Rattanarojpong, T., Vanichviriyakit, R., and Senapin, S. (2017a). **Emergence of tilapia lake virus in Thailand and an alternative semi-nested RT-PCR for detection.** *Aquaculture* 476, 111–118.

Public health – There is no known public health concern for this pathogen, there is a significant risk of TiLV being translocated both inter- and intra-continently through the movement of infected live tilapias in the absence of appropriate biosecurity measures.

What should countries do?

Tilapia producing countries need to be vigilant and take appropriate risk management measures, e.g. enhanced screening and diagnostic testing of imported stocks and unexplained tilapia mortalities and reporting to biosecurity authorities, active surveillance, public information campaigns and contingency plans) to reduce the further spread and potential socio-economic impacts of this emerging disease. FAO GIEWS Special Alert 338 provides a number of specific recommendations:

Imports of tilapias – Countries importing tilapias of any species for use in aquaculture or for the ornamental fish industry are urged to take appropriate risk management measures to reduce the likelihood that imported stocks are infected with TiLV. These measures should include:

- Screening or diagnostic testing of the imported stocks for presence of TiLV, applying the presumptive and confirmatory methods outlined in the OIE Disease Card;
- Requirement of an international health certificate for shipments originating from infected or suspect countries, certifying the absence of TiLV;
- Quarantine and monitoring of imported stocks upon arrival for any unusual mortalities and diagnostic testing if such mortalities occur;
- Contingency planning to ensure containment and eradication if TiLV is present;

- Chapter 5.4 of the OIE Aquatic Animal Health Code¹⁸ on criteria to assess the safety of aquatic animal commodities applies.

Countries with confirmed cases of TiLV, recommendations include:

- Initiate an active surveillance programme to determine the geographical extent of the infection;
- Undertake mitigation measures to restrict the spread of infection and identify risk factors that may assist in appropriate interventions;
- Initiate risk communication and public information campaigns to advise aquaculturists of the threat posed by TiLV, its clinical signs, potential economic and social impacts, and the need to report unexplained large-scale mortalities to biosecurity authorities;
- Conduct appropriate diagnostic testings, where unexplained mortalities of tilapias occur, particularly if clinical signs similar to those reported for TiLV are observed.

Countries with unknown status of TiLV, recommendation include:

- Initiate an active surveillance programme to determine if TiLV is present as well as to identify the susceptible species and country distribution.
- Initiate public information campaigns to advise aquaculturists of the threat posed by TiLV, its clinical signs and the need to report unexplained large-scale mortalities to biosecurity authorities.

Since the release of TiLV information, several countries have initiated TiLV surveillance; these include China, Colombia, India, Indonesia, Malaysia, Mexico, the Philippines, Viet Nam. In Israel, a private vaccines company is currently working on the development of live attenuated vaccine for TiLV.

Few reports are available providing scientific information about TiLV so there is still a huge knowledge gap. As in other transboundary aquatic animal diseases (TAADs) experienced in the past, it seems that there is a significant lapse from the time that a disease is first observed, to the first scientific report describing the disease and the causative agent, up until scientific and/or official reports from affected countries become available. In the case of TiLV, the first observation was in 2009 in Israel¹⁹, and identification of causative agent was reported in 2016. The case of Acute hepatopancreatic necrosis disease (AHPND) of shrimp is a similar case, i.e. it was first observed in 2009 and finally diagnosed in 2013. In aquaculture, there are limitations in diagnostic techniques, there exists cryptic pathogens and benign organisms may become pathogenic when introduced to new hosts and new environments. The emergence of new pathogens challenging aquaculture may also be due to the rapid development of



Nile tilapia (*Oreochromis niloticus*) clinical signs of TiLV infection showing opacity of the eyes, and skin erosions

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the sector, limitations in control options for aquatic animal diseases, occurrence of multi-factorial disease syndromes, frequent sub-clinical infections in aquatic animals, undomesticated status of aquatic animals and little information of health status of aquatic animals.

Efforts should be focused on prevention, maintaining a healthy aquatic environment and putting in place a progressive and robust biosecurity management framework. An old adage “an ounce of prevention is worth a pound of cure” - is an expression which means that it is better to avoid (proactive) the problem in the first place rather than trying to fix them when they arise (reactive) and this needs to be applied to sustain the aquaculture sector. Fish pathology and biosecurity are indispensable and absolute necessities in any aquaculture endeavor.

¹⁸ http://www.oie.int/index.php?id=171&L=0&htmfile=chapitre_criteria_commodities.htm

¹⁹ www.theatlantic.com/science/archive/2016/04/a-new-fish-virus-shows-how-vulnerable-our-food-supplies-are/476847/

Outcomes of the COFI Sub-Committee on Fish Trade

The Republic of Korea's second largest city, Busan, played host to FAO's sixteenth session of the COFI Sub-Committee on Fish Trade during the week of 4-8 September 2017. Representatives from 34 FAO Member countries in addition to observers from international organizations, NGOs and the seafood industry, discussed issues of relevance for international fish trade, making recommendations for FAO's work in this area.

The COFI Sub-Committee on Fish Trade has been meeting every two years, beginning in 1986. According to FAO statistics presented at the meeting, trends in the first half of 2017 indicate that exports of fish and fishery products – excluding aquatic plants – are set to reach an all-time high for 2017 exceeding 150 billion USD. With developing countries representing a full 60% of volume of international fish trade, trade continues to be an important driver for economic growth and socioeconomic development around the world.

During the week-long discussions, Sub-Committee delegates stressed this important role of fish trade as an engine of economic growth, especially for many developing countries. However, the participants also noted with concern, the numerous measures that could jeopardize developing countries' roles as major players in the international fish trade environment. While it is important to support better tools and measures that will guarantee the sustainability of seafood products reaching

consumers' plates, it is also crucial to ensure that measures do not create unnecessary barriers to trade.

The Sub-Committee also supported the important work FAO undertakes in helping developing countries to adopt measures and instruments related to promoting sustainable fisheries, to improve their standards for food safety and hygiene, and to build important capacity in the fisheries sector, thereby allowing these countries to strengthen their role in international fish trade and to gain access to the world's largest fish trade markets.

The agenda included for the first time social and labour issues in the fisheries value-chain. The Sub-Committee reconfirmed its support for the closer collaboration between FAO and the International Labour Organization (ILO) on these important issues. The debate reflected a growing interest in the international community to look beyond the environmental sustainability of fisheries, which has been the primary focus over the past two decades, to concentrate new efforts on ensuring that fish is being caught and processed in a manner in keeping with the socioeconomic sustainability of all those employed in the sector.

The Sub-Committee also provides information about the important role the regional fisheries management organizations (RFMOs) play in fostering robust regional fisheries management programmes.

The Sub-Committee voiced strong support for the work of the joint FAO- World Health Organization (WHO) CODEX Alimentarius food safety and standards. This work is especially crucial for developing countries working to strengthen their fisheries and aquaculture sectors, and aiming to export into major global markets. FAO has an



From left, Mazifur Rahman (Bangladesh, chair of Drafting Committee); Aurora de Blas (Spain, new Chair of Sub-Committee); Audun Lem (FAO, Secretary of Sub-Committee); Professor Park (Republic of Korea, outgoing Chair of Sub-Committee); Stefania Vannuccini (FAO), Gloria Loriente (FAO) and Marcio Castro (FAO)

important role to play in developing capacity in these countries.

Since the last Sub-Committee meeting took place, new FAO instruments have come into effect to curb illegal, unregulated and unreported (IUU) fishing. These include the FAO Port State Measures Agreement, which went into effect on 5 June 2016, and the FAO Catch Documentation Schemes, which were approved by FAO Conference in July 2017. Delegations expressed support for these instruments, alongside FAO's Global Record of Fishing Vessels, Refrigerated Transport and Supply Vessels, which – working together – provide an excellent opportunity to end IUU fishing around the world.

Following a week of active discussions, the work of the COFI Sub-Committee came to an end, but not before electing the Chair and Vice-Chair of the next COFI Sub-Committee on Fish Trade – the Seventeenth Session.

FAO is pleased to announce, that for the first time, a Session of the COFI Sub-Committee will be chaired by an all-woman team. Aurora de Blas of Spain will serve as Chair, while Reina Sotillo de Galagano of Argentina will provide support as Vice-Chair. FAO congratulates the capable leadership of the forthcoming meeting, and looks forward to welcoming delegates to the Seventeenth session of the COFI Sub-Committee on Fish Trade in Vigo, Spain, in 2019!



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SEE ALSO

COFI Sub-Committee on Fish Trade
www.fao.org/about/meetings/cofi-sub-committee-on-fish-trade/en/

FAO supported the World Aquaculture 2017 Conference in Cape Town, South Africa

The World Aquaculture 2017 conference was held in Cape Town, South Africa from 26 to 30 June 2017, and was organized by the World Aquaculture Society and hosted by the Aquaculture Association of Southern Africa and the Department of Agriculture, Forestry and Fisheries of South Africa. The conference was attended by more than 1 400 participants, mainly from Africa. The themes of the conference were Sustainable Aquaculture and New Frontiers for Economic Growth, with a Spotlight on Africa". It also included, parallel meetings to discuss issues affecting the development of aquaculture in Africa. The first meeting was organized by Southern African Development Community (SADC) and WorldFish to strengthening collaboration among existing organizations in Southern African countries; a second meeting organized by the African Union Inter-African Bureau for Animal Resources (AU-IBAR) discussed the strategy of AU for promoting aquaculture development in Africa; and a third meeting organized by WorldFish focused on African aquaculture policy. FAO Aquaculture Officers attended these meetings and actively contributed to the discussions and outcomes. At the opening of the conference, Rohana Subasinghe, former Chief of FAO Aquaculture Branch, delivered a presentation entitled: "Feeding the nine billion: the role of aquaculture" mostly based on FAO aquaculture statistics and flagship publications. Five presentations were delivered by FAO Officers: (i) Improving the technical and economic performance of tilapia aquaculture: a perspective from bio-economic modelling; (ii) Aquaculture growth potential – perspective from short-term projection of future fish demand; (iii) Assessment and monitoring of



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SEE ALSO

World Aquaculture 2017 conference:
www.was.org/meetings/Default.aspx?code=WA2017



FAO-WorldFish exhibition stand at WAS17

global tilapia market; (iv) Assessment and monitoring species diversification in global aquaculture; and (v) An overview of desert aquaculture in North Africa.

The sessions of the conference included tilapia nutrition and genetic, integrated aquaculture and aquaponics, climate change, education, training and technology transfer, aquaculture biosecurity, species diversification, development, welfare and poverty alleviation. A special session was dedicated to the possible establishment of a WAS chapter for Africa to facilitate information exchange, technology transfer and investments to support the development of the sector.

A joint FAO-WorldFish exhibition stand was presented in the exhibit area of the International Convention Centre. The FAO part of the stand was funded by FAO office in Tanzania, and was used to promote some aquaculture projects in Zanzibar and in Southern Africa and to display relevant FAO aquaculture publications such as technical papers, meeting reports, training material, etc.

The conference was well organized. Attendance was mostly from African countries, but there was also a good representation from other continents (i.e. North and South America, Europe, Asia and Australia).

The conference was an opportunity to meet aquaculturists and industry stakeholders to discuss issues and opportunities related to African aquaculture research and development. The conference also facilitated networking and knowledge sharing and launched the idea of establishing a WAS chapter for Africa in collaboration with the major players in Southern Africa such as AU-IBAR, SADC, WorldFish, FAO, etc. The development of an African chapter of WAS will secure a major and continued interaction among aquaculture stakeholders and more visibility of the sector in the continent for potential investors from the public and private sector.

Conference-Dialogue on Blue Growth and Economy: Sharing Perspectives and Experiences for Africa

The concept of Blue Growth or Blue Economy is an outcome of the Rio+20 discussions that took place in 2012, based on the concept of the Green Economy but with a focus on aquatic systems. As defined by FAO, Blue Growth describes an integrated and holistic approach that aims at reconciling economic growth with improved livelihoods and social equity, and strengthening transparent, reliable and more secure food systems, whereas Blue Economy includes all activities, sectors, institutions and stakeholders impacting Blue Growth potentials. The approach is currently implemented by various countries and regions of the world and in its "Agenda 2063 – The Africa we want", the African Union highlighted its potential for the continent while committing itself to speed-up actions to develop it. On its side, FAO launched a Blue Growth Initiative, based on the sound principals of the Code of Conduct for Responsible Fisheries and aimed at creating an enabling environment for those involved in fisheries and aquaculture to act not only as resource users but also to play an active role in protecting and safeguarding these natural resources for the benefit of future generations.



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This Conference-Dialogue that took place in Mindelo (Cabo Verde) from 2 to 4 May 2017, was part of the FAO-Cabo Verde joint initiative in connection with the African Development Bank's support to the transition towards Blue Economy. Some 150 participants from 30 delegations, primarily from African coastal nations, Small Island Developing States (SIDS) and International organizations attended, as well as ministerial delegations from six countries. Fifteen sessions allowed to share perspectives and experiences on all socio-economic, natural and technical dimensions of Blue Growth. The conditions for aquaculture to contribute to and benefit from Blue Growth were also discussed, especially with regards to the enabling and disabling factors, anticipated impacts, and contribution to Sustainable Development Goals.

The Conference-Dialogue was a success in terms of attendance and outcomes. It contributed to the Ocean Conference organized by the United Nations in New York from 5 to 9 June 2017 as well as to the preparation of an Information Document for the Special event on "Aquaculture in the Small Island Developing States (SIDS): Blue Growth opportunities for SIDS in a changing climate"



Women on the Island of Sal in Cabo Verde await the return of the fishermen

to take place at the Ninth Session of the COFI Sub-Committee on Aquaculture from 24 to 27 October 2017 in Rome, Italy.



SEE ALSO

Video of Blue Growth Charter in Capo Verde:

www.youtube.com/watch?v=cmw4kvfUnZI

United Nations Conference on Sustainable Development, Rio+20: <https://sustainabledevelopment.un.org/rio20.html>

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In this issue of FAN see article titled: "Advancing Sustainable Aquaculture through Blue Growth" at page 39.

AQUACULTURE UPDATES BY REGION

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Regional Consultation on Responsible Production and Use of Feed and Feed Ingredients for Sustainable Growth of Aquaculture in Asia-Pacific

Asia is the region that contributes 92 percent of the world aquaculture production. Currently, aquaculture supplied over 60 percent of food fish directly consumed by Asian population. In addition to its contribution to the regional food security and nutritional improvement, Asia is also the major supplier for seafood trade globally.

The past aquaculture production growth in Asia has been largely attributed to intensification of production with increasing dependence on artificial feeding. Aquaculture commodities produced through partial or complete feeding accounted

for 45.2 percent of globally aquaculture production in 2014, compared with 42.5 percent 10 years ago. The total production of fed aquaculture species increased by 97.9 percent in the past 10 years.

The rapid growth of production of fed cultured species has resulted in drastic increase in demand for commercial feed. As a result, industrial aqua-feed production has increased at significantly higher rate than aquaculture production growth. The increased use of feed in aquaculture has greatly contributed to production efficiency and quality of products, and enabled farmers to better meet market requirements and achieve sound economic benefit. On the other hand, rapid increase in aquafeed use has also caused a number of issues which may threaten the sustainable growth of the industry in Asia-Pacific. The major issues include the following:

- Increased feed cost has caused significant reduction of profit

margin in production of many important aquaculture commodities. Feed cost often accounts for 60-70 percent for commodities that entirely depend on artificial feed due to high cost of feed, low feed quality and poor feeding practices;

- In general, Asian aqua-feed production has become overly dependent on externally sourced key ingredients, such as fishmeal and soybean, which has not only pushed the price higher in the international market, but also led to potential supply problem due to competition.

The foreseen population and economy growth will increase demand for food fish significantly, estimated 31 million tonnes in the coming decades. In order to meet the demand for fish, it is important to maintain the sustainable growth of aquaculture in Asia, the major supplier of aquaculture production. Whether the issues related to aquaculture



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feed and feed ingredients can be effectively addressed is considered as one of the determining factors for aquaculture sustainable development in the region. A regional consultation on responsible production and use of aquaculture feed and ingredients was identified by Asia-Pacific Fishery Commission as an important regional activity for FAO Regional Initiative for Blue Growth in Asia-Pacific.

The objective of the regional consultation was to review the current situation of aquaculture feed production and use, in respects of production status, demand and supply, sourcing of ingredients, government policies and institutional support, ongoing progress and development issues. The consultation attempted to recommend regional strategies and actions to promote responsible utilization of feed and feed ingredients for sustainable growth of aquaculture in Asia-Pacific through sharing of available knowledge, technological innovations and scaling up successful practices and further research and technology development.

The regional consultation covered four main themes:

- Development and use of alternatives of fishmeal and other high cost aquafeed ingredients in the region;
- Promote cost-effective aquaculture feed made of locally available feed ingredients in the region;
- Innovation in aquaculture farming and feeding practices for reduced feed costs and environment impacts at farm level;
- Traceability of aquaculture products in relation to feed and feed ingredients.

The regional consultation was convened through collaboration between FAO and the Network of Aquaculture Centres in Asia-Pacific



Working group discussion during the regional consultation

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from 7-9 March 2017 in Bangkok, Thailand. Representatives from concerned government authorities of 16 countries, 10 invited resource persons and 13 experts from research and education institutes, feed producers, farm association, aqua-feed manufacture sector and international and regional organizations participated in the regional consultation.

Invited resource persons delivered presentations on 10 selected topics highly relevant to responsible production and use of aquaculture feed and feed ingredients.

Representative from 16 countries presented country status report on aquaculture feed production and use, which focused on aquafeed manufacture sector, application aquafeed, research and development progress in feed and feed ingredients and main issues and gaps based on the desk study with the advice from FAO and NACA. Two working group sessions were convened to analyze the major issues and gaps in production and use of aquaculture feed and feed ingredients and recommend regional strategy and actions for promoting responsible production and use of aquafeed and feed ingredients for sustainable growth of aquaculture in the region.

The regional consultation provided a great opportunity for sharing available knowledge and successful technologies and good management practices related to responsible use of aquaculture feed and feed ingredients in the region. Major issues and technology gaps related to responsible use of aquaculture feed and feed ingredients are identified as below:

- Being the major aquaculture region in the world, aquafeed sector is heavily dependent on imported key feed ingredients, particularly protein source, which is a potential threat to sustainable growth of aquaculture in the region;
- In general, Asian aquafeed sector is not able to provide quality feed that meet the requirement of different species, different culture environment/system and different stages;
- Large number of small farmers have poor access to quality and cost-effective feed in many countries in the region;
- Good feeding practices and other farming practices are yet to be promoted among the large number of small farmers for optimum feed efficiency;
- Despite the progress in developing local alternatives to key imported feed ingredients such as fish meal, the application in practical production has been very limited due to lack of efforts to transform research results into commercially applicable technologies;
- There is generally lack of conducive government policy for aquafeed industry and adequate regulatory framework to control the quality of aquafeed production and marketing.

The regional consultation recommended strategy and follow-up actions for promoting responsible use of aquaculture feed and feed ingredients for sustainable growth of aquaculture in the region. The workshop proceeding is being finalized and will be published by the end of 2017.

Ensuring sustainable expansion of aquaculture in Bangladesh



Inception workshop of the project

The aquaculture sector of Bangladesh has seen a rapid increase from a production of about 0.7 million tonnes in 2001 to over two million tonnes in 2015, a growth of nearly 200 percent in 15 years. It is anticipated that aquaculture production in Bangladesh will expand further, but the sustainability of its development will depend much on the efficient, socially equitable, and environmentally friendly use of the resources of and inputs to production. Two of the key inputs in aquaculture are seed and feed. To address this concern, an FAO project was launched in 2014 to focus on production and supply of quality seed and feed, increased capacities of farmers for aquaculture management and production, a viable, sustainable

and socially responsible seed and feed production and supply industry, and the efficient and effective management and technical support system for seed and feed production, distribution and utilization.

A USD 451 000 Technical Cooperation Programme (TCP) titled "Enhancing aquaculture production for food security and rural development through better seed and feed production and management with special focus on public-private partnership" was implemented for a period of

32 months (June 2014 - January 2017). The project accomplished the following results: i) A pilot project for improved broodstock management of Indian major carp species was conducted in selected government and private hatcheries/feed seed multiplication farms; ii) A pilot-scale selective breeding programme was conducted in one government hatchery; iii) A national action plan to support the implementation of the comprehensive long-term selective breeding programmes for commercially important selected aquaculture fish species was developed; iv) A strategy and management plan for broodstock improvement for Indian major carps was developed; v) Fish Hatchery Act (2010) and Rules (2011) were reviewed and potential amendments were proposed; vi) Human capacity of private and public hatcheries for breeding and hatchery management was enhanced through training; vii) Fish and Animal Feed Act (2010) and Fish Feed Rules (2011) were reviewed and potential revisions were proposed including revisions to the list of feed



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Rearing of Indian major carp spawn collected from three River systems: Padma, Jamuna and Halda

additives and binders sanctioned for use in aquafeeds; viii) A pilot-scale feed quality analytical laboratory was established; ix) A plan for national aquafeed control programme was developed; xi) An inventory of aquaculture additives being used in aquafarming was prepared and their efficacy was reviewed; xii) Human capacity of small- and medium-scale feed producers was enhanced through training; and xiii) Better hatchery and feed management practice guidelines were developed.

The overall outcome of the project was the improvement in the quality, supply of seed and feed in Bangladesh, particularly for Indian major carps. Specifically, it helped enhancing seed quality by improving broodstock management, initiating a selective breeding program for roho labeo (*Labeo rohita*) and developing better hatchery management practice guidelines for private sector hatcheries. It assisted to improve aquafeed quality by establishing a pilot-scale feed quality analytical laboratory, setting up of a National Aquafeed Control Programme to monitor feed quality and developing better feed production guidelines/manuals.



Measuring broodstock of Indian carp during the genetic selection programme, Bangladesh

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SEE ALSO

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Fingerlings of Indian major carps

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Highlight of Aquaculture Focused Country Projects (TCPs) in Asia-Pacific

Support local feed self-sufficiency for inland aquaculture development in Indonesia

Aquaculture in Indonesia has been growing very rapidly in freshwater, brackish water and marine environments. The fast growth of the sector resulted in significantly increased use of aquafeed. Out of 9.3 million tonnes of targeted fish and shrimp feed production in 2015, nearly 50 percent was to meet the requirements of freshwater fish. Availability of quality and cost-effective aquafeed has become a main constraint in the development of aquaculture. Increasing cost of feed in freshwater fish farming in Indonesia (often accounts for 60-70 percent of the total production cost) has become a major factor that discourages fish farmers to develop their business, because of low profit margins. Achieving feed self-sufficiency for sustainable aquaculture development has become a priority agenda of the Ministry of Marine Affairs and Fisheries of Government of Indonesia. Therefore, responding to the request of the government of Indonesia, a field investigation, and a review study followed by a stakeholder consultation were undertaken in early 2017, to support the formulation of a recently approved project titled



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Verification workshop for the elaboration of the project, Jakarta, Indonesia

“Supporting local feed self-sufficiency for inland aquaculture in Indonesia”. The expected outputs of the project are the following:

Output 1: Collection and analysis of baseline information on feed ingredient supply and availability and identification of novel feed ingredients for use in aquafeed and key factors influencing their availability and costs, and nutritional requirements of commonly cultured species in Indonesia;

Output 2: Improved feed formulations for catfish and other key inland fish species with locally available ingredients and strengthened capacity of small-scale feed manufacturers to produce quality and cost-effective feeds;

Output 3: Optimization of on-farm feed management strategies and successful trial of high quality and cost-effective feed formulations for on-grower feeds for striped catfish (*Pangasius hypophthalmus*);

Output 4: Development and promotion of appropriate institutional, policy and regulatory frameworks for

aquafeed (including feed additives and quality standards) manufacturing, quality control and management and strategy to improve supply of locally available feed ingredients.

The project will effectively strengthen the capacity of small feed mills to produce high quality and cost-effective feed with increased local ingredients for small freshwater fish farmers and improved feeding management practices.

Piloting sustainable shrimp farming in Bac Lieu and Soc Trang Province, Viet Nam

As an important industry, shrimp contributes approximately 50 percent of the total export from fisheries sector, and estimated annual production growth rate for 2013 – 2014 was about 20 percent. The farmed shrimp production comes mainly from the lower Mekong River provinces of Bac Lieu, Ca Mau, Tra Vinh, Ben Tre, Soc Trang and Kien Giang. Intensive shrimp farming is concentrated largely in Soc Trang and Bac Lieu provinces. Each of the two provinces has more than

52 000 hectares of intensive and semi-intensive shrimp farming. The estimated shrimp production in 2014 is 67 000 tonnes and 95 000 tonnes in Soc Trang and Bac Lieu respectively.

Along with the rapid development of intensive and semi-intensive shrimp farming, small-scale farmers have suffered from serious disease outbreak in Viet Nam in recent years. The losses of farmed shrimp due to diseases are most severe in Soc Trang and Bac Lieu, which affected 26-40 percent of total shrimp farming area and put the small-scale and poor farmers in the most vulnerable position. Moreover, the unplanned development of shrimp farms in the mangrove forest has caused environmental problems and sustainability concerns.

In order to support the government efforts to achieve sustainable growth of shrimp farming in southern Viet Nam, an FAO-TCP project was approved in December 2014 and implemented during 2015-2017 under the regional initiative for blue growth in Asia-Pacific.

The project first focused on an assessment study of the

impacts of failed intensive shrimp farming on livelihoods of small-scale farmers and identified feasible technical solutions to address the major problem of shrimp farming. Based on the findings from the assessment study, technical guidelines on two improved shrimp farming models, integrated rice-shrimp farming (IRSF) and semi-intensive shrimp farming were developed for guiding the demonstration in Soc Trang and Bac Lieu Provinces. Capacity development activities were carried out for the farmer organizations involved in the demonstration, which included the training on improved production practices and community organizational skills. Demonstration of integrated farming of rice-tiger shrimp and improved semi-intensive farming of whiteleg shrimp was conducted at two selected sites in both Bac Lieu and Soc Trang Provinces. At each site, five farms were selected for demonstrating recommended farming models against three control farms (farms followed the old practices).

Taking the demonstration in Soc Trang Province as an example, the farms that adopted improved

semi-intensive shrimp model achieved significantly improved production performance than the control farms. The whole technical and economic indicators include improved survival rate (+22.1 percent), higher unit production (+67 percent), more than doubled net return per unit culture area (+130 percent) and significantly higher ratio of profit margin.

The integrated rice-shrimp model included one crop of concurrent rice-giant freshwater prawn in rainy season and one crop of sole black tiger prawn in dry season. The demonstration farmers achieved results of higher rice yield than the control farmers in rainy season together with additional production of giant freshwater prawn (*Macrobrachium rosenbergii*), 675.4 kg/ha in rainy season and an additional crop of black tiger prawn (*Penaeus monodon*), 1115 kg/ha in dry season. The production of giant freshwater prawn and black tiger prawn brought the farmer additional net return of 79.2 million VND (1 USD=22729.50 VND), which was 14 times of the net return from rice production.

A final project evaluation workshop was convened in Bac Lieu on 21 July 2017, to evaluate the implementation and results of the project and to share information and lessons learnt among the different stakeholders. The Directorate of Fisheries and the two provincial governments anticipated that IRSF and improved semi-intensive shrimp practices will be further improved and scaling up in Southern Viet Nam.



Shrimp farming in Viet Nam

Regional Initiative to Promote Scaling up of Innovative Agro-Aquaculture and Climate Resilient Tilapia Farming Practices

FAO Asia and Pacific's regional initiative for Blue Growth was launched in 2014. One of the main objectives of this initiative is to promote innovative farming practices for sustainable increase of productivity in aquaculture in selected focus countries. In particular, the regional initiative supported demonstration of innovative rice-aquaculture in Indonesia and Viet Nam and climate resilient tilapia farming practices in the Philippines in 2015-2016.

Therefore, to disseminate the technological advancement and good farming management practices successfully demonstrated through individual country project activities, a regional TCP (Technical Cooperation Programme) titled: "Support scaling up of innovative rice-fish farming and climate resilient tilapia culture practices for blue growth in Asia-Pacific" (TCP/RAS/3603) was formulated and approved at the end of 2016. The project supports five countries, namely Bangladesh, Indonesia, Philippines, Sri Lanka and Viet Nam to scale up innovative rice-fish farming and climate resilient tilapia culture. The major expected outputs of the regional TCP include:

- Technical guidelines for innovative rice-fish farming and climate resilient tilapia culture are prepared based on projects implemented earlier, verified and finalized through regional consultation and country level demonstrations;
- Country level capacity for scaling up innovative rice-fish farming and climate resilient tilapia culture are strengthened through training activities at regional and national level and farm demonstration;
- A national strategy and project are formulated to support the intensification of innovative rice-fish farming and climate resilient tilapia culture in each participating country.

The TCP started with an inception workshop conducted in May 2017 attended by the national project coordinators and key technical staff from all selected countries. During the two days workshop, the participants revisited the project framework, discussed project activities and prepared draft country level implementation plan. The draft technical guidelines for innovative rice-fish farming and climate resilient tilapia culture will be completed in early September and ready for conducting the regional training and verification workshop scheduled during 12-14 September



Plenary session during the workshop

2017. Country level project activities will start immediately after the workshop, which will include local training, demonstration of selected farming practices, formulation of national strategy/program support scaling up of innovative rice-fish farming and climate resilient tilapia culture and national dissemination workshop. A final workshop will be organized to share the results and lessons learnt from the country and finalize the technical guidelines across the region.

As a joint effort to expand innovative agro-aquaculture in Asia-Pacific, FAO Strategic Programme 2 (SP2) supported a regional workshop on Integrated Agro-Aquaculture for Blue Growth in Asia-Pacific held in Kunming, China from 12-17 June 2017. Over 30 fisheries and agriculture officers and experts from 6 countries participated in this event. The invited experts introduced up to date technology and farming practices of Integrated Agro-Aquaculture. The participating countries presented recent development of integrated agro-aquaculture in respective countries. The participants visited famous Hani Terrace Rice-fish System in Honghe County, Yunnan Province. The national teams prepared draft policy and business pitch for scaling up innovative integrated agro-aquaculture in the participating countries.



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International Conference on Marine Spatial Planning, Ecosystem Approach and Supporting Information Systems



Working group participating in a policy game about marine spatial planning (www.mspchallenge.info)

Fisheries and aquaculture can no longer be considered in isolation from the range of other activities that use the marine space. To ensure long-term sustainability for all marine activities, it is increasingly necessary to holistically manage marine areas within an ecosystem approach to aquaculture. This has promoted the concept and development of marine spatial planning (MSP).¹

The international conference on “Marine Spatial Planning, Ecosystem Approach and Supporting Information Systems” took place at the University of Las Palmas de Gran Canaria from 25 to 28 April 2017. It was organized by the EU EcoAqua project² and the University of Las Palmas de Gran Canaria.

The main objective of this conference was to bring together a broad range of stakeholders, including policy-makers, regulators, developers and

scientists, to discuss issues, methodologies and best practices for MSP. Approximately 110 participants from 14 different countries attended. The conference offered three main sessions over four days and presentations were both technical and industry-oriented. More than 44 oral and 33 poster presentations were delivered.

The conference covered a broad spectrum of topics including: current challenges and opportunities for MSP; legal instruments for MSP; MSP frameworks; stakeholder analysis for MSP; marine strategies and environmental planning; biodiversity conservation; marine data collection and analysis; and marine information systems. FAO made a presentation entitled “*Marine spatial planning for enhanced fisheries and aquaculture sustainability*” and chaired the last session on MSP and blue growth. This session consisted of five presentations and a wrap-up session. FAO was also part of the panel that selected the conference’s best poster.

The conference focused primarily on presentations from institutions and enterprises working on MSP, but it also included three training workshops that allowed for group discussions and brainstorming sessions.

In recent years, MSP has experienced vigorous growth on an international scale. Even though an array of practices has emerged from different countries, MSP still faces many political, social, economic and environmental challenges. Moreover, dynamic ocean management in transboundary scenarios, coupled with global climate change, represent evolving challenges that require flexible and adaptive planning.

Because MSP is a long-term process – and one that may involve wide geographic areas, complex partnerships, cooperation and data sharing – the outputs are typically slow to materialize and to be disseminated. However, the potential benefits of MSP are likely to include: facilitating sector growth; optimizing the sustainable use of the sea; expediting and reducing costs of information; transboundary cooperation and better regulation; planning and decision-making. Good MSP design will rely upon forward thinking, strong stakeholder engagement, shared resources, efficient monitoring and an adoption of ecosystem-based approaches.



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1 There are many definitions of MSP. A useful one is provided by Ehler and Douvère (2009) who describe MSP as “a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process”.

2 The five-year (2014–2019) EU EcoAqua project is aimed at building a centre of excellence and a networking hub for research into sustainable aquaculture, for application in the EU’s outermost regions, and in overseas countries and territories that comprise 34 states located across all the major regions of the globe, from tropical to polar latitudes.



SEE ALSO

Meaden, G.J., Aguilar-Manjarrez, J., Corner, R.A., O’Hagan, A.M. & Cardia, F. 2016. *Marine spatial planning for enhanced fisheries and aquaculture sustainability – its application in the Near East*. FAO Fisheries and Aquaculture Technical Paper No. 604. Rome, FAO. 89 pp. www.fao.org/3/a-i6043e.pdf

European Fisheries and Aquaculture Forum 2017

The Fisheries and Aquaculture Forum is an opportunity to share information, interact with buyers, suppliers, distributors and traders of seafood throughout Europe. The 2017 Forum took place in Vigo, Spain from 23 to 24 May 2017 and was organized by the international NGO Sustainable Fisheries Partnership (SFP).

Almost 100 people attended the Forum which covered a wide variety of subjects pertinent to sustainability, including the EU Common Fisheries Policy's landing obligation, discussions and presentations on regional fishery improvement projects, and the future of sustainable aquaculture. FAO made a presentation entitled "Aquaculture zoning and area management - a governance perspective" as part of a session on "Government and industry efforts towards zonal management in aquaculture".

The Forum acknowledged that area (or zonal) management can be an effective tool for improving aquaculture governance and management; enabling farmers to work together; protect the environment; improve production; develop sufficient economies of scale and knowledge to participate in modern market chains; increase their ability to join certification schemes; improve the reliability of production; reduce risks such as disease; and minimize conflict with other natural resource users. FAO and SFP are taking a fresh view of the challenges and opportunities of working at the area/zonal scale.

By attending this conference FAO gained a valuable opportunity to present a recent FAO/World Bank publication – "Aquaculture zoning, site selection and area management under the ecosystem approach to aquaculture" – and to network with people active in aquaculture in Europe. SFP is playing an active role in promoting a zonal management approach and supports industry players that want to take practical action. For example, in Hainan, China, SFP worked with industry stakeholders to improve the sustainability of tilapia farming. As a result, that sector is now employing zonal aquaculture with positive results. Similar projects are planned for pangasius and shrimp.



Tilapia cage culture in Beihai, China

© COURTESY OF J. MORALES

When there are several farms in an enclosed or contained waterbody, it is essential to develop and implement an area management plan to minimize the risks of disease and environmental damage.

Tilapia is cultured in many types of production systems. This flexibility makes the fish attractive to subsistence and commercial farmers in many parts of the world. Tilapia is also a favourite with consumers. Fish from this farm in China are destined for the American market, although local consumption is increasing.

Strong demand for tilapia is driving increased production around the world in ponds and cages, in fresh and brackish water. However, as the industry grows, the risks also grow. Farmers must do their part to reduce environmental and disease risks on each farm as part of a larger resource management system that will protect the quality of water resources and the livelihoods of producers. Standardizing production practices and coordinating disease risks through area management strategies are key aspects for ensuring sustainable growth of the industry.

FAO and SFP will continue to promote the concept of area/zonal management, encouraging multiple farming operations – even those run by competitors – to work together to tackle cumulative environmental impacts on individual farms, shared disease risks that continue to plague the industry, and make sure that shared resources such as waterways aren't contaminated by common discharge.



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SEE ALSO

FAO & World Bank. 2015. *Aquaculture zoning, site selection and area management under the ecosystem approach to aquaculture*. Policy brief. Rome, FAO. <http://www.fao.org/documents/card/en/c/4c777b3a-6afc-4475-bfc2-a51646471b0d/>

Aguilar-Manjarrez, J., Soto, D. & Brummett, R. 2017. *Aquaculture zoning, site selection and area management under the ecosystem approach to aquaculture*. Full document. Report ACS113536. Rome, FAO, and World Bank Group, Washington, DC. 395 pp. www.fao.org/3/a-i6992e.pdf

Support to the National Agency for the Development of Aquaculture (ANDA) in Morocco

With a coastline extending over nearly 3 500 km along both the Mediterranean sea and the Atlantic ocean, as well as a seafood production exceeding one million metric tonnes, Moroccan fisheries present major economic and social challenges and opportunities for the country. In 2009, the government formulated its new strategy for the sector, called the Halieutis Plan, which provides a mainstreaming vision and sets ambitious targets, particularly for aquaculture development. One of the first consequences was the establishment in 2011 of the National Agency for the Development of Aquaculture (ANDA), whose mission is to guide and promote the development of the sector.

In a context where the production from capture fisheries is stagnating, the Halieutis Plan calls for an increase in Moroccan marine aquaculture production, which was 470 metric tonnes/\$US 2 million in 2015 and consisted mainly of oysters (65 percent), and European seabass (35 percent). It also calls for aquaculture to generate employment and serve as a means for the integration of Morocco in the global seafood trade. Small-scale aquaculture development is considered as another priority, especially with regard to promoting the cohabitation of

small-scale fisheries and aquaculture, as well as the involvement of rural populations youth and empowerment of women.

ANDA was created on 18 February 2011 in support to the National strategy and in only 5 years, it has been able to initiate and implement a large number of activities in areas as diverse as: (1) Development of a legal framework specific for aquaculture; (2) Planning of various aquaculture management areas; (3) A guide for investemnt in aquaculture; (4) Backstopping of investors willing to create aquaculture enterprises; (5) Launching of public-private partnership pilot projects; and (6) Establishment of a national marine aquaculture hatchery.

The main objective of the FAO Technical Cooperation Programme (TCP) entitled "Support to the development of a strategy for the development of aquaculture in Morocco" is to strengthen the technical capacities of ANDA staff by assisting them in evaluating planned actions of the Agency. More precisely, it will carry out an evaluation of the Agency's National and Regional achievements and ensure they are in line with the international instruments promoting sustainable aquaculture development. Based on this, a new strategic framework will be proposed as well as a five-year action plan. The project is organized around 3 outputs:

Output 1: The Aquaculture Management Areas Plans developed by ANDA are evaluated and recommendations are made for their alignment with international instruments;

Output 2: The sectoral activities implemented by ANDA at the



Participants at the inception Workshop

National level are assessed and recommendations are made to support the Agency in carrying out its mission;

Output 3: A strategic framework for the development of aquaculture to 2030 and a five-year action plan for its implementation are developed.

The project started on 15 February 2017 and activities will run for 12 months.

As concluded by FAO's Representative in Morocco, Michael Hage, "Morocco is well-placed to position itself in the aquaculture sector. The Halieutis strategy launched in 2009 and the establishment of the National Agency for Aquaculture Development in 2011 reflect the firm political will to develop a thriving aquaculture sector. The National Agency for Aquaculture Development is poised to serve as a motor that will drive Morocco's fisheries and aquaculture sectors to prominence."



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SEE ALSO

FAO Blue Growth Blog:

<http://www.fao.org/blogs/blue-growth-blog/morocco-a-maritime-fishing-nation-works-to-develop-its-aquaculture-sector/en/>

National Agency for Aquaculture Development:

www.anda.gov.ma/

Ninth Session of the Regional Commission for Fisheries (RECOFI)



Participants at the Ninth Session of RECOFI

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 the sustainable development of aquaculture within its competence area. The Ninth Session of the Regional Commission was held in Kuwait, State of Kuwait, from 9-11 May 2017. The session was attended by 20 delegates from five member countries of the Commission, namely State of Iraq, State of Kuwait, Sultanate of Oman, State of Qatar and Kingdom of Saudi Arabia, and six invited organizations (United Nations Environment, Regional Organization for the Protection of the Marine Environment (ROPME),

Emirates Wildlife Society - WWF, King Abdulaziz City for Science and Technology (KACST), Kuwait Institute for Scientific Research (KISR) and Qatar University).

The Session was briefed on the administrative and 2016-17 intersessional period activities, publications, progress on the proposed Memorandum of Understanding (MoU) between FAO (on behalf of RECOFI) and Regional Organization for the Protection of the Marine Environment (ROPME). The financial affairs of the Commission were also detailed, including the intersessional period expenditures, the status of membership contributions to the RECOFI autonomous budget and outstanding arrears.

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period expenditures, the status of membership contributions to the RECOFI autonomous budget and outstanding arrears.

- A need for external extra-budgetary resources was highlighted. The Session recalled the Secretariat on the need of support coordinating the process of increasing the current fixed amount of Member contributions to a level which allows the Commission to deliver its outcomes in an effective and efficient way.
- A call was made by the Secretariat to Member states to consider becoming a party to FAO Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing, known as FAO Agreement on Port State Measures (PSMA).
- The Commission endorsed the Working Group on Fisheries Management (WGFM) proposal to add two mullet species to the RECOFI list of the fish species listed for assessment and management purposes (priority list), namely Klunzinger's mullet (*Liza klunzingeri*) and greenback mullet (*Liza subviridis*). The Session reaffirmed adequacy



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of the current data collection mechanisms of relevance to status of fishing operations and marine fishery resources within the scope of monitoring and facilitating management decisions. The Commission requested WGFM to work towards better alignment and consistency of the mechanisms used for the submission of marine fisheries data. It was agreed that the catch and effort data submitted by Members will be harmonized and integrated in an Excel format. The Commission agreed to proceed with the standard FAO aquaculture data questionnaires for use at national and regional levels.

- The Commission decided to hold the regular meetings of its subsidiary bodies (i.e. Working Group on Aquaculture and Working Group on Fisheries Management) every two years starting from 2017.

- As part of a review agenda item, the Commission reviewed its achievements, the key challenges it faces and the activities conducted during 2005-2015. The following two possible scenarios were suggested for consideration of the Session in terms of improved functionality of the Commission: (1) Maintain RECOFI activities within current budget and reduced FAO support; (2) Strengthen RECOFI to function with an increased budget and secretariat. Discussions were later focused on the key challenges, the limiting financial status of the Commission, the need for strengthening the effectiveness and functionality of the Commission, the Session noted that issues related to the strengthening of the Commission were discussed over the last Sessions. Although the Session acknowledged the Review, the Session agreed

- on the official submission of the Review to the respective Ministers of each Member State for further decision and guidance. In this regard, the organization of an ad hoc session was considered as an appropriate opportunity to achieve a final decision.
- The Commission enforced a two-year programme of work for 2017-18 intersessional period. It includes workshops on aquatic animal biosecurity and on the joint assessment of the Kingfish stocks in addition to regular meetings of the two RECOFI working groups.
- The next session of RECOFI is scheduled to be held in 2018.



SEE ALSO

Regional Commission for Fisheries (RECOFI)

<http://www.fao.org/fishery/rfb/recofi/en>

Regional Aquaculture Information System (RAIS)

www.raisaquaculture.net

A new website dedicated to Aquatic Genetic Resources (AqGR) for Food and Agriculture has been launched!



Food and Agriculture Organization of the United Nations

The establishment of a web page specifically devoted to AqGR was recommended by the COFI Advisory Working Group on Aquatic Genetic Resources and Technologies during its first meeting in October 2015.

The website highlights the ongoing efforts of the Fisheries and Aquaculture Department in collecting and disseminating information on the global status of AqGR, and in promoting their responsible use and conservation, including efforts being made under the guidance of the Commission on Genetic Resources for Food and Agriculture and the FAO Committee on Fisheries' Sub-Committee on Aquaculture (COFI:AQ).

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www.fao.org/aquatic-genetic-resources



Aquaculture Expansion in a Landlocked Country, the Case of Paraguay

Paraguay is one of the two landlocked countries of Latin America (the other one being Bolivia). It is a sub-tropical country with 6.7 million inhabitants, located in South America. Whilst it has been traditionally a major exporter of agriculture products, of which soybean and beef account for more than 74 percent (BCP, 2016 in Paraguay.com, 2016), the country possesses a vast hydrological network stemming from three major rivers: Pilcomayo (835 km); Paraguay (1 265 km) and Parana (689 km) which, together with 7 large lakes and hydro electrical reservoirs that cover more than 4 000 km², provide electricity, water, food and livelihoods for a large proportion of its population.

The first attempts to cultivate fish in the country date back some 70 years ago and although there are some 258 native fish species identified in the country, most aquaculture preliminary trials used exotic species, particularly common carp and tilapia (FAO, 2010). Apart from these isolated efforts, commercial aquaculture was almost nonexistent until the late 1990's, when two mid-sized, closed-cycle tilapia farms which produced fish for the market of Asuncion, the capital city, started operations.



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In 2009 the Viceministry of Animal Husbandry (Ministry of Agriculture) requested FAO's assistance to develop a national aquaculture development plan (NADP); as a result, a technical cooperation project (TCP) was formulated as a starting point through which a national participatory aquaculture sector diagnostic was realized as a basis for the formulation of the NADP.

With the exception of two companies with more than 50 ha of fish ponds, some 2 900 small-scale farmers (0.22 ha pond surface area in average) were identified in the country at the time of the diagnostic. Some of the weaknesses and limitations identified through this nationwide exercise included: i) lack of a national aquaculture registry and statistical system; ii) low farm productivity due to the lack of technical capacities and poor production management; iii) weak economic sustainability of small-scale farmers, associated to high production costs and low yields; iv) lack of processing capabilities and limited access to markets; v) most farmers were not part of organizations thus economies of scale were not sought; vi) aquaculture was not prioritized by the government and hence no institution had aquaculture in its mandate, vi) national fish consumption was very low (4.4 kg in average) with a strong cultural preference for beef (FAO, 2010).

By 2011, FAO assisted the government in the participatory formulation of the NADP.

A comprehensive consultation to a wide range of stakeholders was carried out throughout

the country, and a first-ever aquaculture development road map was collectively formulated. The major lines of action prioritized for immediate implementation were: a national strategy to increase fish consumption; a specific legal framework to foster sustainable aquaculture development; a national program to strengthen the technical capacities of both extension workers and farmers; the creation of a national Directorate of Aquaculture; a national aquaculture registry; the creation of a postgraduate course on fish farming; strengthening the small-scale farmers organizations and promote better and more sustainable aquaculture practices, including the involvement of the State Secretariat of the Environment.

Table 1 presents some indicators of impact of the intervention. Overall aquaculture production increased fourfold in 7 years. The number of farms has increased also substantially although the scale remains unchanged. With the exception of a couple of new export-oriented projects, the increasing internal market is supplied by small-scale farmers. Moreover, given the positive outcome of the hands-on processing courses provided to farmers, a mobile processing plant was designed with FAO's technical assistance and operates itinerantly among production zones (Photo 1).

An Aquaculture Development Law was formulated with FAO's assistance and was enacted in 2010. Also a new Aquaculture Directorate within the Viceministry

Table 1 – Comparison of sector development indicators ex-ante and ex-post* the implementation of the National Aquaculture Development Plan

Indicator	2009	2017
National Aquaculture Production	2 000 tonnes	9 200 tonnes
Approximate number of aquaculture production units	2 900	3 150
Level of organization	Very weak	Improved. Two new organizations using economies of scale and sharing commercialization channels.
Fish consumption (kg/caput/year)	4.4	6.8
Aquaculture Legal framework	Law of Fisheries and Aquaculture No. 3.556.08	Law of Sustainable Aquaculture Development No.4.050
Opportunities for capacity development in aquaculture	Research and diploma courses at the National University of Asuncion	An Msc and a soon-to-be PhD in natural resources offered by the National University management (including aquaculture)
Presence of value added products in local markets	Less than 3% of the total national supply of aquaculture-produced fish	Over 20% of the national aquaculture fish supply

* Data and information according to: FAO, 2010 (baseline); the Directorate of Aquaculture; the Department of Aquaculture of the Faculty of Veterinary Studies-University of Asuncion and the own author's records.

of Animal Husbandry has been created, which provides extension services and is starting a national registry and statistical follow-up. The future looks bright for aquaculture expansion in Paraguay.



SEE ALSO

FAO. 2010. *Diagnóstico del sector acuícola de Paraguay. Documento Técnico del Proyecto TCP/PAR/3201*. Organización de las Naciones Unidas para la Alimentación y la Agricultura. FAO. Asunción, Paraguay. 47p.

Paraguay.com. 2016. *Qué compra y qué vende Paraguay*. Based on the commercial balance sheets of the Central Bank of Paraguay. www.paraguay.com/nacionales/que-compra-y-que-vende-paraguay-126231



Photo 1 – Mobile fish processing plant for small-scale aquaculture farmers of Paraguay



Farmed cachama (*Colossoma macropomum*), Peru

Adaptation of Fisheries and Aquaculture to Climate Change in Chile

Introduction

Chile is one of the main fish producing countries of the world, with fishing (industrial and artisanal) and aquaculture among the productive activities of major economic and social importance at national level. However, over the past decade both sectors have experienced fluctuations in outputs due to overfishing, and complex management difficulties resulting, among others, in negative socio-economic effects, notably a decline in the overall income of fishing communities.

A number of important fishery resources have been exploited at levels that have exceeded the biological capacity of the ecosystems to recover, hence generating a high degree of vulnerability to environmental changes. In this context, the artisanal sector that exploits and farms commercial aquatic species along the entire coast of the country is identified as the most vulnerable user to environmental effects that cause changes to fishing seasons and species abundance.

In June 2017, the FAO-GEF project "*Strengthening the Adaptation Capacity of the Chilean Fisheries and Aquaculture Sector for Climate Change*" was launched, which



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will develop pilot experiences in four coves located in different geographic areas of the country. The initiative, a pioneer in Chile, seeks to outline key guidelines that lead to the implementation at the national level of a management system for fisheries and aquaculture with capabilities to adapt to climate change.

This project, to be implemented through to September 2020, is funded by the Global Environment Facility (GEF) and implemented by the Food and Agriculture Organization of the United Nations (FAO). The Chilean Fisheries and Aquaculture authority (the "Subsecretaría de Pesca y Acuicultura") and the Ministry of the Environment are the national executing agencies.

Work in the bays

According to the United Nations Framework Convention on Climate Change, Chile is a highly vulnerable country in the face of climate change. Throughout the long Chilean coastline there are large number of sites where coastal resources are of great importance in the local economies and where strong historical and cultural links exist between such communities and the exploitation of such resources. For this reason, these socio-economic realities are highly sensitivity to any environmental variability.

The project seeks to help overcome barriers such as weaknesses in



Farmed Peruvian calico scallop (*Argopecten purpuratus*)

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the institutional framework (at national and local levels) and limited application of good practices in the fishery and aquaculture sector, especially in the area of technological innovation. Furthermore, the project aims at strengthening knowledge and awareness on climate change directly in the pilot coastal communities so as to increase awareness on the need to adapt aquatic resources management and exploitation in the face of environmental impacts some of which are clearly occurring and impacting the availability of the resources.

The project is working in four small bays spread across the length of the country all of which have distinct fisheries, aquaculture activities and climatic conditions. These are the Riquelme Cove in the Region of Tarapacá (North Zone); Tongoy in the Region of Coquimbo (Central-North Zone); Coliumo in the Bío-Bío Region (Central-South Zone); and El Manzano, in the Los Lagos Region (Southern Zone). The lessons learned on environmental, technical, socio-economic and institutional adaptation to climate change accomplished in the pilot sites will be replicated elsewhere and at a much larger scale.



Through an inclusive and participatory approach, work will be carried out jointly with artisanal fishermen communities and alliances will be established with other key stakeholders in the sector, including government and community institutions, research centers, civil society organizations and others key entities both public and private. The project will also seek to profit from local knowledge and exchange experiences generating synergistic actions that will strengthen the ability to adapt to climate change at all levels.

All project activities will be implemented through an ecosystem and precautionary approach contemplated in the Chilean legal framework, which promotes integrated practices in relation to the conservation, restoration and use of marine resources and the inclusion of the diverse stakeholders in the decision making.

Small-scale aquaculture

Within the overall Chilean fisheries sector, aquaculture has gradually gained importance, currently representing the fastest growing food sector. Although, aquaculture has developed

through the farming of a relatively limited number of aquatic species - seven fish, eight molluscs and five seaweed - currently species diversification of the sector is being promoted through a National Aquaculture Policy.

In a framework of environmental sustainability and equity, small-scale aquaculture is considered an economic activity with opportunities to grow because of its potential to strengthen and complement the work of artisanal fishers affected by the decline of some of their target and traditional resources.

Thus, in the pilot bays of the project - and where aquaculture initiatives are developed to a greater or lesser extent - fishing communities have expressed their interest in knowing and analyzing new alternatives that allow them to adapt to the new challenges. Currently in the bay of Tongoy at least 50 percent of the fishers

is engaged in the cultivation of the Peruvian calico scallop (*Argopecten purpuratus*), while in El Manzano (Los Lagos Region) the fishers have started collecting seeds and farming the Chilean mussel (*Mytilus chilensis*). In the other two coves, small-scale aquaculture is only just emerging, with some experiences in the cultivation of *Gracilaria* in the bay of Coliumo.

Conclusions

The GEF-FAO project, which is just beginning, is a response to the threats that climate change is exerting on the fishery resources and on the most vulnerable user group, the small-scale fishers. It is expected that the outputs of the project will increase the overall resilience of the Chilean commercial fishing and aquaculture industries and hopefully provide guidance to neighboring and further afar countries which will be also dealing with the menace brought about by climate changes.



Scallop farmer in the Bay of Tongoy

Results of a Regional Workshop on Occupational Security for Diving Fishers in Latin America: Towards Decent Rural Employment

The regional workshop on “Diving in fisheries and aquaculture: legislation and policy recommendations” was held during 30-31 January in Tegucigalpa, Honduras. Forty participants including occupational hazards experts; hyperbaric medicine doctors; representatives of fishing divers associations; FAO’s national consultants and technical officers, participated in the event. Also representatives of the Organization of the Fisheries and Aquaculture Sectors of Central America (OSPESCA), the Inter-American Development Bank (IDB) and government officers of Colombia, Chile, Honduras, Mexico and Peru convened at Tegucigalpa, the capital city of Honduras.

The objective of the workshop was to disseminate the results of a baseline study on the labor and occupational safety in diving fishing and aquaculture, carried out in Colombia, Chile, Honduras and Mexico, as well as to discuss ways to improve the current national legislation and regulatory frameworks regarding diving fishing and make legislation and policy recommendations accordingly. The Chilean diving fishing regulatory and legal framework was used as a reference, given its soundness and long history.

The main common weaknesses identified throughout the rest of the country study-cases were: i) lack of national legal frameworks specific for diving in fisheries and aquaculture; ii) lack of training opportunities for diving fishers to ensure safe and better practices; iii) absence of strict compulsory regulations to ensure occupational safety; iv) adequate first aid and hyperbaric chambers are scarce or nonexistent, as well as are specialists in hyperbaric medicine in fishing communities; v) most diving fishers are not included in social protection systems to guarantee family insurance in case of disability or death and vi) the lack of a multisectoral approach to local economic development to minimize the almost exclusive dependence on diving fishing.



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Participants at the workshop held in Tegucigalpa, Honduras

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Group discussion after delivered presentations, led to a number of conclusions and recommendations in terms of legal frameworks and policies; institutional arrangements and practical matters to ensure the reduction of fishing-related diving accidents. These included:

- Carry out censuses of fishing divers in all countries where such an activity is common. They should not only include quantitative information, but also information on the level of their training/expertise, the type and conditions of the diving-support equipment and other relevant socio-economic data.
- Governments should include in their national pertinent legislation, a specific section ensuring rights and obligations of fishers, aiming at their occupational safety, thus ensuring decent employment conditions.
- Differentiated occupational and social protection policies according to the level of risk of diving fishing, should be formulated by national Governments to ensure equal social protection opportunities.
- Urgent need to revise the current pensum of medical school programs, to introduce or improve training of general physicians, in hyperbaric medicine. This includes the development of specialized courses to train rural doctors so that coastal communities have access to such a critical expertise.
- Mapping of fishing communities with respect to the availability of hyperbaric chambers should be the basis for a national program to improve first aid and hyperbaric medical attention systems.
- Detailed and holistic assessments should be carried out by national fisheries authorities, to introduce safer capture methods in fisheries that currently employ diving, to reduce accidents and fatalities.

Financing African Aquaculture for Sustainable Economic Development

A special session on “Financing African Aquaculture” was held on 27th of June 2017 as part of the World Aquaculture 2017 conference in Cape Town, South Africa. The session started with a brief overview of “Aquaculture Businesses in Africa” by Randall Brummett and a presentation on “Funding models for inclusive aquaculture development in Africa” by Junning Cai in lieu of his colleague Felix Marttin. After the introductory presentations, invited speakers from the private and public sectors shared their experiences and views about conducting aquaculture as a business in Africa through eight additional presentations as well as interactions with the audience. Key findings or messages conveyed by the presentations and discussion are summarized as follows.

Bryan McCoy and Adam Taylor shared their experience of fish farming in Zambia. Their company (named Yalelo) produces fresh tilapia for local consumers. In addition to many technical challenges, they also need to find ways to sell the fish when their production is scaled up – the

attractive market price can drop very quickly when the supply is increased. They have handled the marketing challenge by establishing their own distribution network.

Robert Jenkins discussed the “Msingi Approach” to address structural factors inhibiting growth of a successful aquaculture industry in East Africa through an integrated plan. This approach would require a significant level of investments to provide concessionary finance for long-term benefits. Such investments may require a public-private partnership that includes grants from government or donors and investments from the private sector. Public funding is used to facilitate the concessionary finance, whereas the private partner ensures proper governance and management.

Patrick Seruyange from the Delegation of the European Union to Uganda introduced the “aquaculture park” project

in Uganda. The cage-based aquaculture park (designed for tilapia production) would be located at Mwena, a landing site near Kalangala Island on Lake Victoria with existing infrastructure that can be used for aquaculture activities. The pond-based aquaculture park (designed for catfish and/or tilapia production) would be located on the banks of the River Nile where it leaves Lake Kyoga north of Masindi Port for easy access to the water source.

André Bok, an aquaculture entrepreneur, shared his insights about the complicity between developer optimism and investor ignorance in the underperformance of the South African marine fish farming industry. He suggested that some simple tools can help navigate the quagmire of aquaculture failures in the region, and instil confidence in reorienting the industry towards achieving its development potential. He pointed out that



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Feeding Nile tilapia in Lake Volta, Ghana. The first-prize winner in the SARNISSA African Cage Culture Photo Competition: Pierre-Olivier Maquart

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aquaculture is a technically demanding business; it takes years of practices and experiences to fully appreciate the importance of water quality to the success of an aquaculture operation.

Amy Novogratz shared her visions about investing in the future of aquaculture in Africa through Aqua-Spark, an investment fund with a focus on sustainable aquaculture businesses around the world. Some of the key messages she conveyed in her presentation were: “we do not seek controlling stakes in our investments; we are long-term investors who do not seek exit strategies; every business we invest in is a reflection of our trust in the entrepreneur to lead their companies’ development and growth in the most effective way.”

Lionel Brenner, an aquaculture financial consultant, gave a presentation on the financial gap for aquaculture in South Africa. He pointed out that financial institutions often lack understanding of the risks inherent in the aquaculture sector and how to value opportunities. He also underlined that the

sector will not attract sufficient funds unless there is a shift in the attitudes of investors and their appetite to fund aquaculture projects. He suggested that aquaculturists should reassess their role in shaping and crafting the investment experience and bridging the funding gap.

Gavin Johnston and Willem Schoonbee discussed lessons learned from AquaPemba, a pilot venture to produce Dusky Kob/ Mulloway fish (*Argyrosomus japonicus*) in Pemba Bay, Mozambique. The early successes of the project did not lead to a sustainable commercial business so the project was shut down after six years of operations despite having a business plan backed by a track record and operational success in the pilot phase. Various external factors (e.g. policy, licencing, financing, supply chains and distance from markets) have contributed to the non-success.

Lisa Geswindt and Brian Soldaat from the government of South Africa gave a brief yet comprehensive overview of aquaculture investment

opportunities and incentives in South Africa. Their presentations have generated much interest and discussion from the audience, especially fish farmers in South Africa who would like to have a more enabling environment for aquaculture development in the country.

Most participants agreed that finance is an important factor for the development of the African aquaculture sector. Until recently, however, not enough attention has been placed on this issue. To support financing in Africa, participants in this session identified three main courses of actions: (i) the public sector should improve rules and regulations regarding aquaculture and related activities and on top of that, transparent enforcement of these rules and regulations should be a priority; (ii) the finance sector should familiarize itself with the aquaculture sector so that risks can be appropriately assessed, mitigated and shared for reducing financial costs; and (iii) the aquaculture sector should be more serious about conducting their operations as businesses, with a focus on economic performance. Participants also agreed that more emphasis needs to be placed on proper (and generally conservative) business planning in the aquaculture sector. Many investments are too optimistic and do not properly evaluate and plan for external risks. Finance needs to be patient and pragmatic.



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Yalelo Fish Farm in Zambia. Harvest is done mechanically



SEE ALSO

World Aquaculture 2017 conference:
<https://www.was.org/meetings/default.aspx?code=WA2017>

Seventeenth Session of the Committee on Inland Fisheries and Aquaculture of Africa (CIFAA)

The Committee for Inland Fisheries and Aquaculture of Africa (CIFAA) was established by the FAO Council in 1971 and is an Article VI body of the FAO constitution dealing with inland fisheries and aquaculture in sub-Saharan Africa and is composed by 37 member countries. The Secretariat is provided by the FAO Regional Office for Africa based in Accra, Ghana. The Committee Ordinary Sessions are held every two years. This Committee represents a unique forum for its members to discuss emerging issues on inland fisheries and aquaculture at the national and regional scale. However, one of the major issues of this Committee in recent years is the difficulty in reaching a quorum to allow for consensus in decision-making.

The Seventeenth Session of CIFAA was held in Banjul, Gambia from 9 to 11 May 2017. A total of 28 delegates from ten member countries and three observers attended the Session. Three working documents and five information documents were presented and discussed in the plenary by the secretariat, namely: (i) Follow up to intersessional activities and way forward; (ii) Outcomes of the Aquaculture Network for Africa (ANAF) annual meeting; and (iii) Status of inland fisheries in Africa.

The CIFAA Session achieved its objectives despite the low attendance. Participants identified a number of priorities to enhance regional cooperation and strengthen technical inland fisheries and aquaculture capacities for CIFAA member countries. Six priority areas were identified and a work plan and budget elaborated for the next biennium. The six priorities for the future work of the Committee are: (i) ecological capacity of inland water bodies for fish cage farming, (ii) roles of sub-regional lake and river bodies in inland fishery management, (iii) impact of Nile tilapia trade: imported vs. locally produced fish, (iv) aquaculture production sustainability (profitability vs. socio-economic considerations), (v) fish diseases and environmental constraints, (vi) integrated aquaculture farming systems to make production more profitable.



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Participants attending the 17th CIFAA Session in Banjul, Gambia

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The Seventeenth Session of CIFAA:

- deplored the long inter-sessional period but appreciated the efforts of the Secretariat to revitalize the Committee.
- noted the strong need to assume ownership of the Committee by its members.
- noted that an innovative approach is required for reenergizing CIFAA.
- agreed that CIFAA is to remain as an Article VI body under the FAO constitution. It was highlighted that CIFAA acts as a means to voice African inland fisheries and aquaculture matters to the global stage in large events such as the Committee on Fisheries (COFI).
- recommended that CIFAA secretariat conduct an attendance review of all CIFAA sessions. This review should highlight the regularly attending member states, the low attending member states, the never attending member states and their levels of representation.
- recommended that the working group on the CIFAA multi donor trusts fund created during the Dakar extraordinary session operationalize itself under CIFAA Secretariat leadership.
- endorsed the proposal to integrate ANAF within the African Union structure (AU-IBAR).
- acknowledged the need for regular and updated inland fisheries and aquaculture statistics.
- noted the readiness of the African Development Bank to assist countries in carrying out their Blue Economy programs with an emphasis on inland fisheries and Aquaculture.

Mali offered to host the next ordinary Session of CIFAA to be held in two years' time.



SEE ALSO

Committee on Inland Fisheries and Aquaculture of Africa

www.fao.org/fishery/rfb/cifaa/en

FAO Report of the 17th CIFAA Session

(not yet published)

Fish and Cassava Stop Migration in Guinea-Bissau

The Africa Solidarity Trust Fund (ASTF) requested FAO to implement a project in six West-African nations to generate youth employment in the fields of aquaculture and cassava value chains. The total budget amounts to approximately four million US dollars. Planting cassava is quite straightforward, but interestingly, the six countries had their own ideas about aquaculture interventions: one country concentrated on fish ponds, another on fiberglass tanks and a few also on floating cages. All these farming systems concentrated on two main cultured species tilapia and North African catfish.

In Guinea Bissau floating cages for fish culture were used to attract youth into fish rearing operations. A special formula was developed with so-called “core” farmers, land owners, who then collaborated with young “satellite” farmers. The fish cages were deployed in a river (freshwater environment) and in an estuary (brackish water environment) and filled with tilapia fingerlings from Senegal, two species, according to their natural habitats.

The selected youth had been trained by the project’s international consultant from Senegal in cage assemblage, mooring techniques and cage management (e.g. protection against predators and transport of fingerlings). The project provided the fish and the feed and then

the youth were left on their own to feed the fish and maintain the cages. The consultant, on his regular visits, taught them how to sample the fish and record the growth performance. The cassava group in the meantime continued to weed their satellite farms.

Then the day arrives for the first big harvest. The cassava had performed well and harvests between one and four tonnes were recorded, great successes for the cassava farmers, who also produced their own saplings for the next production cycle. During a support mission from the FAO Regional Office for Africa it was noted that the cages were full of harvestable fish. Of course, when the fish have reached the marketable size, special attention has to be given to surveillance in case an outsider decides to harvest the fish prematurely. During the usual Question and Answer sessions, sharing information on the feeding frequency, timing of feeding, mortality, bird predation, and other technical details, it was the time for the youth to pose questions. In the meantime half of the villagers had appeared on the river bank, listening to all the fish talk. Appreciation was expressed for FAO’s role in the project to rear fish and grow cassava. Suddenly an

elderly lady said that FAO, through the cassava and fish project, had stopped migration from the village. That was a real eye-opener. The emphasis had always been put on scoring a high number of created jobs, so that the financing agency would see that their funds were well spent and that all team players were doing a great job. With that “migration” remark, suddenly it was realized how important the role played by a good project in day-to-day village life is. The visitors were definitely moved by the lady’s conclusion and although there was a sense of pride and hope in that, there was also the awareness on the way back to the capital Bissau that there is still a lot to do as everywhere in the villages the streets were full of youth, on their way to or from school. After graduation, however, these adolescents will deserve employment also. The good news from the village of Pitche in Guinea Bissau will hopefully encourage the ASTF to continue financing such initiatives. The Fund may count on FAO’s commitment to make future initiatives a success, too.

Special acknowledgments of the efforts made by the national FAO team and international consultant, the core farmers and of course the youth groups.



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Villagers and youth negotiating fish price

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Nigeria: Faster Aquaculture Growth Needed to Bridge Fish Demand-Supply Gap

In 1980, 73 million Nigerians consumed 984 thousand tonnes of fish- the equivalent of 13 kg per person per year and nearly 1 kg more than the world average. Between 1980 and 2013, the country's population increased to 172 million and total fish consumption increased by 1 333 thousand tonnes to 2 317 thousand tonnes - allowing for per capita fish consumption to remain virtually unchanged. Nigeria's 2013 per capita fish consumption had however fallen to 70 percent of the world average (20 kg per person per year). Despite fish consumption remaining stable, overall per capita animal protein intake in the country fell from 10.07g in 1980 to 9.85g in 2013. This

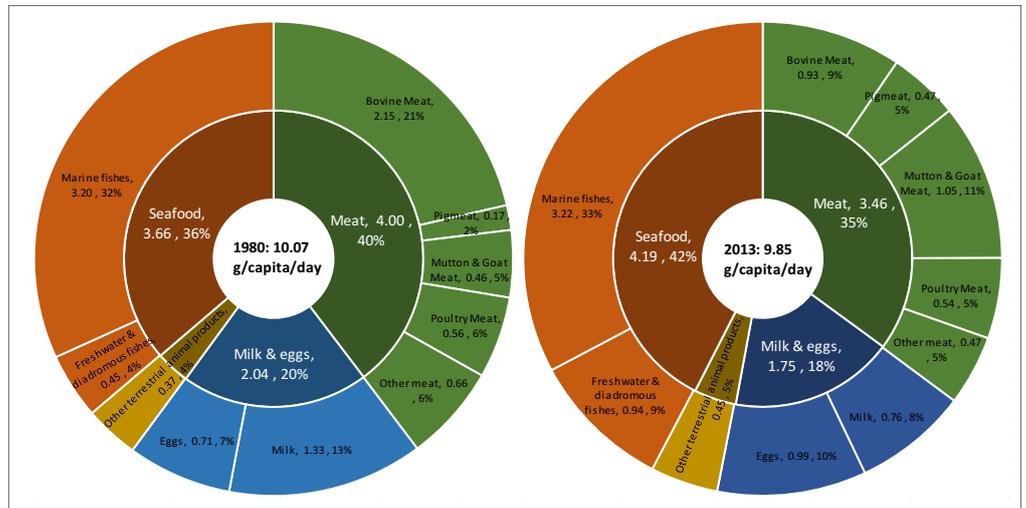


Figure 1 – Per capita animal protein intake in Nigeria – 2008 versus 2013

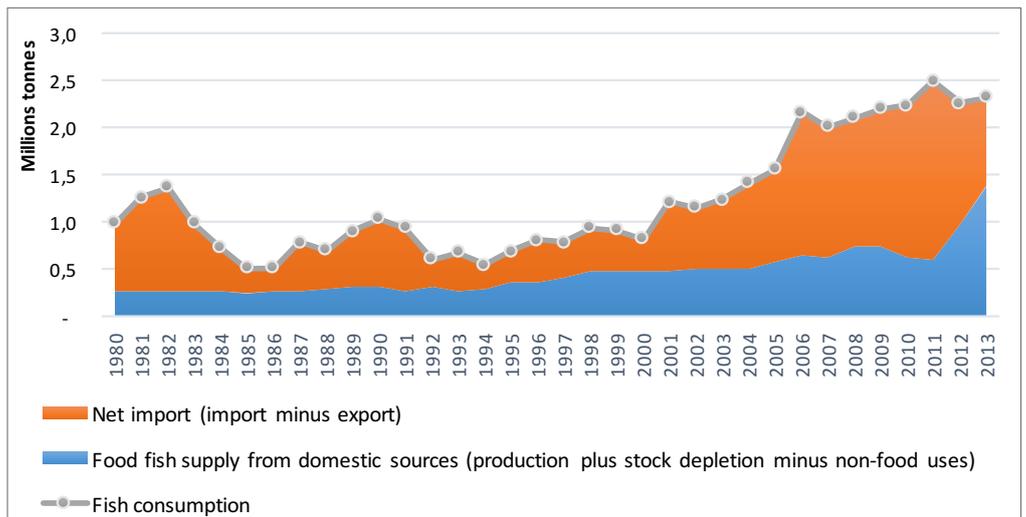


Figure 2 – Nigeria's supply and utilization of fish for food



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decline is the result of a decrease in per capita protein intake from meat and milk (two of the largest animal protein categories), which were unable to keep pace with population growth (Figure 1).

The increase in fish production in Nigeria accounts for 55 percent of the intensification of its total fish consumption (1 333 thousand tonnes) between 1980-2013; the remaining 45 percent was covered by the growth in its net import (i.e. import minus export) of fish. Nigeria's fish trade deficit

increased from 350 thousand tonnes to nearly 2 million tonnes between 2000 and 2011 before declining to 940 thousand tonnes in 2013 thanks to a rapid increase in domestic fish production (Figure 2).



SEE ALSO

FAO. 2017. *Short-term projection of global fish demand and supply gaps*. Cai, J. & Leung, P.S. FAO Fisheries and Aquaculture Technical Paper No. 607. Rome, Italy. www.fao.org/3/a-i7623e.pdf

Fish production in Nigeria grew from 260 000 tonnes in 1980 to over 1 million tonnes in 2015. While capture fisheries is still the main source of fish production in the country, the share of aquaculture has increased from 2 percent in 1980 to over 30 percent in 2015 (Figure 3).

Over the past 35 years, aquaculture production in Nigeria has grown 12 percent a year (compared to the world average 8 percent) from a little over 6 000 tonnes in 1980 to nearly 320 000 tonnes in 2015 (Figure 4). The country is the largest aquaculture fish producer in sub-Saharan Africa, accounting for 54 percent of the total fish production in the sub-region.

Nigeria's aquaculture focuses mainly on freshwater fishes, with catfish species accounting for 64 percent of the country's aquaculture production in 2015 (Figure 5).

Looking into the future, if other factors affecting fish demand (e.g. fish price and consumer preference) remain unchanged, Nigeria's fish demand in the early 2020s would be 600 000 tonnes higher than the level in the mid-2010s because of income and population growth in the country. On the other side, following the current trend, its aquaculture

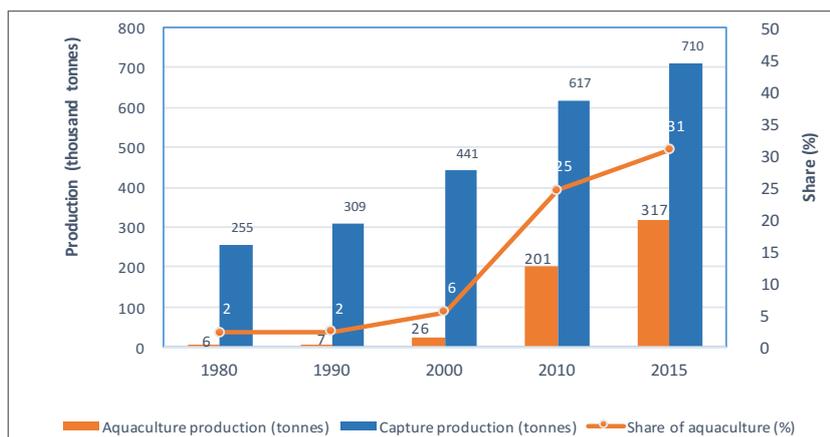


Figure 3 – Status and trends of aquaculture and fisheries production in Nigeria

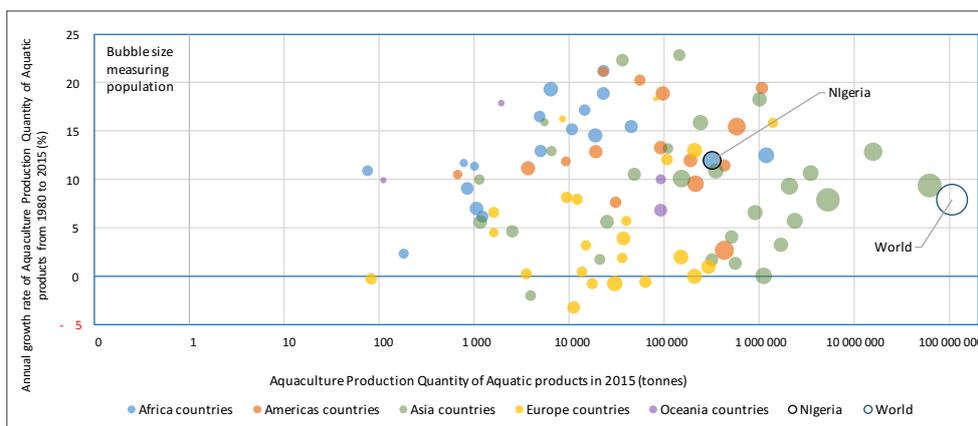


Figure 4 – Status and trend of global aquaculture production – 2015 versus 1980

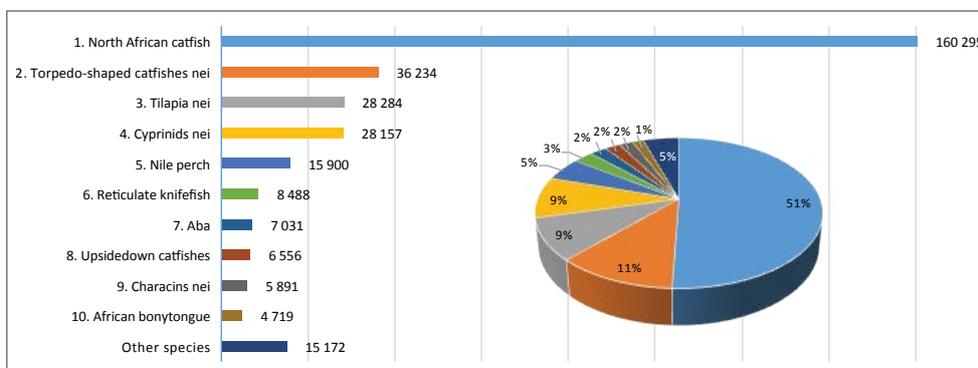


Figure 5 – Top-10 aquaculture species in Nigeria in 2015 (tonnes)

production in the early 2020s would be 150 000 tonnes higher than the level in the mid-2010. This would only be able to cover a quarter of the 600 000 tonnes of demand hike driven by the income and population growth,

resulting in a 450 000 tonnes demand-supply gap. The country's aquaculture would need to grow at 22 percent a year from the mid-2010s to the early 2020s in order to bridge the potential demand-supply gap.



Checking the size of Nile tilapia from an earthen pond, Namibia

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The Regional Capacity Building Workshop on Aquaculture Models and Technologies to Reduce Poverty, Improve Youth Employment and Promote Commercialization



Photo of participants at the workshop

SUMMARY

The capacity building Workshop on Aquaculture Models and Technologies to Reduce Poverty, Improve Youth Employment and Promote Commercialization, was held in Adzopé, Ivory Coast, from 18 to 21 July 2017. The objective of the workshop was to evaluate how and to what extent aquaculture and related activities contribute or can contribute to youth employment and poverty reduction. The workshop was part of the Strategic Programme "Rural Poverty Reduction". Twenty-nine participants attended the

workshop, from Burkina Faso (3), France (4), Ivory Coast (15), Senegal (4), and three FAO resource persons. During the workshop, participants described different types of fish farming models and their interactions along the value chain. Moreover, the technical and economic performances of the different fish farming models, along with their role at both farm and territory levels, have been also analysed. Based on the workshop's results, a publication about the role of aquaculture in creating employment opportunities for rural youth along the value chain will be produced.

Atelier régional de renforcement des capacités sur les modèles et technologies aquacoles permettant de réduire la pauvreté, d'améliorer l'emploi des jeunes et de favoriser la commercialisation

L'atelier régional a eu lieu du 18 au 21 Juillet 2017 dans le Centre de la Société Agro Piscicole (SAP) de la Mé à 15 km d'Adzopé, Côte d'Ivoire.

L'objectif de l'atelier était d'évaluer en quoi et comment la pisciculture intégrée et les activités associées dans les paysages ruraux contribuent ou peuvent contribuer à la création d'emplois des jeunes et plus largement à la réduction de la pauvreté. Il s'inscrit dans le cadre de l'objectif stratégique 3 « Réduire la pauvreté rurale ». Vingt-neuf personnes ont participé à l'atelier, du Burkina Faso (3), de la France (4), de la Côte d'Ivoire (15), du Sénégal (4) et de trois (3) personnes-ressource de la FAO.

La cérémonie d'ouverture a été présidée par le Secrétaire Général de la préfecture d'Adzopé. Les différentes interventions des représentants des autorités, de la FAO et du Centre de coopération internationale en recherche agronomique pour le développement (Cirad) ont été introduites par le chef du Département du Centre de Recherche Océanologique (CRO) d'Abidjan. L'importance économique et sociale de la filière aquacole pour l'Afrique de l'Ouest a été soulignée.

Le premier jour, après la présentation des participants, l'atelier a identifié et décrit, à travers les échanges en plénière, les différents types de pisciculture et de leurs interactions avec les autres composantes de la filière. Le deuxième jour, les participants ont analysé les performances techniques et

économiques des modèles de pisciculture dont ils font la promotion dans leur pays respectif. Le troisième jour, à travers les échanges en plénière, les participants ont discuté le modèle de pisciculture à l'échelle de l'exploitation (par exemple les rôles des jeunes, des anciens et des femmes) et à l'échelle du territoire (par exemple la sécurité alimentaire). Le quatrième jour, pour clôturer l'atelier, une proposition de synthèse a été présentée par les facilitateurs basée sur l'analyse de la capacité de modèles de pisciculture à créer des emplois. Une première analyse du processus de création d'emplois à travers les modèles de pisciculture a été soumise aux participants et discutée en plénière. Ces échanges ont permis de mettre en exergue les qualités consensuelles et controversées, les inconvénients et les enseignements des modèles développés dans des situations territoriales propres à chacun des pays.

Les points traités mais qui mériteraient d'être encore approfondis au-delà de l'atelier ont été listés. Ils portent sur l'accès au foncier des jeunes, la relecture des organisations économiques les plus propices pour porter les innovations piscicoles, la possibilité de partenariat entre les agro-industries et les petites piscicultures, l'importance du dialogue entre les acteurs locaux concernés dans la conception, l'adaptation et la mise en routine de la production, l'implication de la recherche dans les tentatives d'entreprises pilotes et la construction de démarches R&D.

Pour compléter les apports de l'atelier, M. Martinus Van der Knaap, de la FAO, a présenté les avancées du projet GCP/RAF/254/MUL « Création d'opportunités d'emploi des jeunes dans le secteur agroalimentaire via des systèmes aquacoles et des chaînes de valeur du manioc durables en Afrique de l'ouest » financée par le Fonds fiduciaire de solidarité africain.

En guise de clôture, il a été rappelé que conformément au protocole d'accord entre le Cirad et la FAO, les produits attendus comprennent la rédaction du rapport technique de l'atelier et la publication des résultats de ces journées sur le rôle de l'aquaculture intégrée aux systèmes agraires en matière d'emploi des jeunes ruraux tout au long de la filière.



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THEMATIC ARTICLES



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Advancing Sustainable Aquaculture through Blue Growth

Introduction

Since its launch in 2014, the FAO Blue Growth Initiative (BGI) was developed from a concept discussed at Rio+20 to a major area of work with concrete, “on-the-water” examples of sustainable aquaculture and fisheries management being advanced through an integrated, holistic approach. Blue Growth prioritizes balancing the sustainable management of natural aquatic resources with an emphasis on reduced food loss and waste, energy efficiency,

decent work, and technical and financial innovation.

A Blue Growth strategy for aquaculture development differs from business as usual through an integrated framework supporting the three pillars of sustainable development (environmental, social and economic) and facilitating more efficient production while taking stock of countries’ unique conditions and adapting to the local situations. A key aspect is the targeted interventions along the aquaculture value chain, considering the high degree of interaction among actors and interconnectivity of the various sub-sectors. While the concept of “Blue Economy” encompasses all economic activities that use aquatic systems and resources (including sectors such as shipping, tourism and ocean energy), Blue Growth aims to reconcile economic growth resulting from those activities with sustainable aquatic resource use

and social equity to contribute to FAO’s core mandate of poverty alleviation and food security. In short, Blue Growth seeks to minimize environmental degradation, biodiversity loss and unsustainable use of resources while maximizing economic and social benefits.

Sustainable development of aquaculture has received considerable attention in recent years, with many countries increasing production substantially over the past decade. The Blue Growth Initiative offers a comprehensive strategic framework (Figure 1) to help countries build sustainable aquaculture sectors that take into account the 2030 Agenda and Sustainable Development Goals (SDGs). This approach to aquaculture has already proven capable of producing multiple benefits across multiple sectors through FAO Blue Growth activities in several regions and countries.



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Since the launch of the BGI many countries have requested FAO assistance in transitioning to the Blue Growth model with aquaculture often as driving force. This article showcases Blue Growth in the aquaculture sector with a number of FAO's Multipartner Programme Support Mechanism (FMM) projects grouped into three main impact areas – to demonstrate that developing aquaculture using a Blue Growth model can be environmentally responsible, socially inclusive and equitable, economically profitable and offer innovative ways to solve long-standing challenges or limitations in the sector.

Ecosystem Approach to Aquaculture

Aquaculture projects implemented through the BGI build on the Ecosystem Approach to Aquaculture and other FAO technical guidelines, target environmental responsibility through efficient use of ecosystem services and build energy efficiencies (including renewable sources) into aquaculture production and associated sub-sectors.

Bangladesh: Improving Shrimp Aquaculture and Managing Environmental Impacts

In Bangladesh, FAO developed a monitoring tool to assess the impact of shrimp aquaculture on habitats, landscapes and biodiversity, and to devise mitigation measures. Over 130 farmers, government officials and NGO representatives were trained to better understand the environmental impacts of shrimp farming. This project will avoid further degradation and improve the protection of the relevant ecosystems which provide countless ecosystem

services to shrimp farmers who ultimately benefit from improved production, and to their communities from other ecosystem services.

The Philippines: Maximizing Efficiencies with Seaweed Farming

FAO's aquaculture efforts in the Philippines are centred on seaweed production. *Gracilaria*, a high value seaweed species, requires little space (production footprint) for profitable production, benefits the environment and uses little energy. The Philippines have achieved additional environmental and economic efficiencies by reclaiming abandoned fish ponds to farm the seaweed, and promoting species more accessible to small-scale farmers than other forms of coastal aquaculture, such as milkfish (*Chanos chanos*), shrimp (*Penaeus monodon*) or mangrove mudcrab (*Scylla serrata*).

Sri Lanka: Optimizing Production of Inputs – Fish Seed

In Sri Lanka, FAO worked with stakeholders to improve environmental benefits and operational efficiency by optimizing fish seed production efficiency (i.e. small fish/fingerling production). This has been



Oyster farming as an income-generating activity in the mangrove forests of Kiliffi County, Kenya

achieved primarily by switching from land-based to water-based (floating) hatcheries, resulting in increased energy efficiencies by using lakes, ponds and their associated natural processes to perform the same functions as energy-intensive pumps that circulate and filter water.

Socially and Economically Inclusive Aquaculture

Social and economic considerations for resource users and communities are key elements of the BGI approach. Local communities should be engaged and educated about the multiple benefits of a holistic approach to management of their natural resources for long-term sustainability of projects focusing on aquaculture. This entails including traditionally marginalized but equally important stakeholder groups such as women and youth in projects and as key contributors and beneficiaries.

Kenya: Mangrove Preservation and Economic Opportunities

To reverse trends in mangrove deforestation in Kenya's coastal areas, FAO supported community and youth groups consisting of 162 men and 120 women to educate and raise awareness of the value of ecosystem services

provided by mangroves. Since 2015, over 265 000 seedlings have been planted in 38 hectares of degraded mangrove forests in Kilifi and Tana River Counties, with plans for another 70 000 seedlings in 6-7 hectares along the coast by December 2017. In Kenya's mangrove programme several knowledge products were developed to better inform policy and provide strategic advice to government, community stakeholders and potential donors. These include economic valuations for key coastal ecosystems, fish value chain appraisals of production and post-harvest conditions in selected sites, and marine spatial planning for mariculture. Increased knowledge of mangrove ecosystems and their services highlight the potential for new businesses such as fish processing and value adding, aquaculture, mangrove restoration, beekeeping and mariculture associated with ecotourism.

Technical and Financial Innovation

The cross-sectoral assessment of existing activities within the BGI approach informs targeted aquaculture interventions and facilitates the transition from business as usual to a mutually beneficial one. In practice, rather

than superficially addressing the challenges associated with aquaculture development, the BGI approach seeks to identify cross-sectoral tensions across ecological and socioeconomic spheres, to address the root of the problem and achieve transformational change. Often solutions are relatively simple or within the grasp of key stakeholders and can be catalytic, allowing projects to achieve tangible success, increasing the odds for scaling up and mainstreaming Blue Growth actions into development planning.

Barbados: Aquaponics – Technical Innovation

As a small island developing state (SIDS) Barbados' energy, freshwater and other resources are limited and costly. Given these constraints, aquaponics fits well with Barbados' aquaculture plans. Aquaponics combines aquaculture (growing fish) with hydroponics (growing plants in water) and enables Barbados to generate several important environmental benefits and economic efficiencies. First, aquaponics maximizes freshwater use by growing tilapia for local consumption and simultaneously generating high value lettuce crops for restaurants. In addition, Barbados uses solar energy to power its aquaponics system, which is environmentally responsible and economically cheaper than conventional energy sources, using abundant and free sunlight. Finally, materials for aquaponics are easily found in hardware stores and do not need to be specially ordered.

Grenada: Blue Innovation Institute

The large exclusive economic zone of Grenada, another SIDS, offers opportunities to diversify its economy using a Blue Growth



Mangrove forest restoration with community groups in Kilifi, Kenya



©FAO/R. VANANROOY

Aquaponics as a method for farming fish protein and vegetables in Antigua and Barbuda

approach. Grenada, the first country to initiate a master plan for Blue Growth, identified new opportunities in fisheries and aquaculture, blue biotechnology, renewable energy, research and innovation with a Blue Innovation Institute as a cornerstone of its strategy. The institute aims to be a centre of excellence and a think tank on Blue Economy supporting innovative “blue” financing instruments such as Blue Bonds and blue insurance schemes. The vision is to rapidly scale up economic activities that promote ocean health by catalysing innovative and sustainable technologies, programmes, policies and communities to improve food security, increase natural capital, and reduce poverty. FAO is committed to supporting the Blue Innovation Institute by providing technical and financial assistance for workshops to share lessons learned on aquaculture and to support Green Climate Fund fisheries and aquaculture project development in the region.

Viet Nam: Financial Innovation in Catfish Farming

In Viet Nam, aquafeed value chain analysis and the revision of regulatory frameworks for feed production and management are improving feed quality, supply, management practices and feed conversion efficiency to enhance the livelihoods of small-scale catfish farmers. Training and workshops for the stakeholders enhanced their knowledge and increased productivity and sustainability.

Global aquaculture production exceeded 106 million tonnes in 2015 (SOFIA, 2016). Since 2014, the sector is the main source of fish destined for human consumption. Aquaculture has the potential to meet the protein needs and demand for fish as the world population expands. Blue Growth offers an approach for environmentally and socioeconomically sustainable aquaculture. As of August 2017, FAO is working with 23 countries worldwide to develop Blue Growth projects,

with aquaculture in 12 of them. These figures are expected to increase as Blue Growth continues to be included in national and regional development plans for aquaculture and fisheries.

Conclusions

The FAO Blue Growth Initiative can advance sustainable aquaculture not only to achieve the Organization’s core mandate, but also to support countries and partners to implement the 2030 Agenda to achieve the SDGs. The expansion of aquaculture, breeding programmes, farmed species and feed development must be balanced by approaches and innovations that analyse risks, ensure environmental health, render nutritious and safe farmed aquatic products, preserve social benefits and ensure economic viability. Blue Growth can help develop and implement integrated aquaculture management policies and programmes by bringing together various stakeholders and leveraging aquaculture to provide multiple benefits, from reduced food loss and waste and energy consumption, to increases in decent work and innovation.



SEE ALSO

Achieving Blue Growth through implementation of the Code of Conduct for Responsible Fisheries.
http://www.fao.org/fileadmin/user_upload/newsroom/docs/BlueGrowth_LR.pdf

The Blue Growth Initiative and Small Island Developing States (SIDS)
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Ecosystem Approach to Aquaculture
www.fao.org/docrep/013/i1750e/i1750e.pdf

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www.fao.org/3/a-i5555e.pdf

The Impact of Microplastics on Food Safety: the Case of Fishery and Aquaculture Products

Microplastics present in the oceans and inland waters are unintentionally ingested by a large number of aquatic animals of commercial value. These plastic particles are made of compounds such as polymers and additives that vary in their composition depending on the desired final characteristics of the material. These polymers can sorb (either absorb or adsorb) and desorb contaminants from the surrounding environment, which could pose a threat to the food safety of fishery and aquaculture products. To determine the impact on human health of the presence of microplastics in these products, an exposure assessment of plastic polymers, additives, and sorbed contaminants in mussels was conducted by the Fisheries and Aquaculture Department of FAO.

Plastic materials are present in nearly all aspects of modern life, from simple food wrappers, clothes containing synthetic fibres and car tyres to life-sustaining medical equipment. Their manufacture, use and discharge has significantly increased causing their accumulation in



This rainbow runner had consumed 17 plastic fragments. Marine plastic pollution plays an unknown role in human exposures to toxic chemicals. <https://ehp.niehs.nih.gov/123-a34/>

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landfills, oceans and inland waters. In 1950 the global plastic production was 1.7 million metric tons by 2015 this number had grown to 322 million metric tons (Worldwatch Institute, 2015). There are many types of plastic but five dominate global production: polyethylene, polypropylene, polyvinylchloride, polystyrene, and polyethylene terephthalate (GESAMP, 2015). Plastics make their way into the aquatic environment by direct runoff and disintegration of meso and macro plastic debris. Direct release results from untreated sewage, inadequate industrial control, improper human behaviour, and abandoned or lost fishing gear (UNEP, 2017). Most plastics degrade very slowly but when exposed to ultraviolet (UV) light and constant abrasion this process is significantly accelerated.

Microplastics are divided into two main groups. Primary plastics are those intentionally manufactured to be of a particular size; while secondary plastics result from the breakdown of larger materials. Examples of primary microplastics include: pellets, powders, and industrial scrubbers. Additionally, plastics are divided according to

their size into nano, micro and meso. The term nanoplastics refers to particles measuring between 1 and 100 nm, microplastics to particles of 0.1 μm (1 000 nm) to 5 000 μm , and mesoplastics to all materials above 5mm.

Microplastics have been recorded in twelve out of the twenty-five most important species and genera that contribute to global marine fisheries (Lusher, Holmann & Mendoza, 2017). Therefore, they pose an emerging food safety concern because the toxicity of plastic and its components (polymerized monomers, additives and, possibly, adhered contaminants from the oceans) has not been evaluated by relevant international expert scientific committees such as the Joint FAO/WHO Expert Committee on Food Additives (JECFA). Some plastic monomers are known to be carcinogenic or toxic if ingested; however, during polymerization they become less toxic. Many plastic additives are suspected to be endocrine disruptors, and toxic contaminants sorbed by plastics can be released and bioaccumulate in the environment



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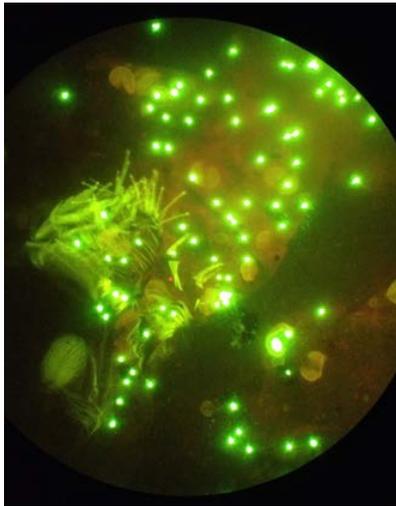
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Musculature of the blue mussel (*Mytilus edulis*) is full of fluorescent microplastic

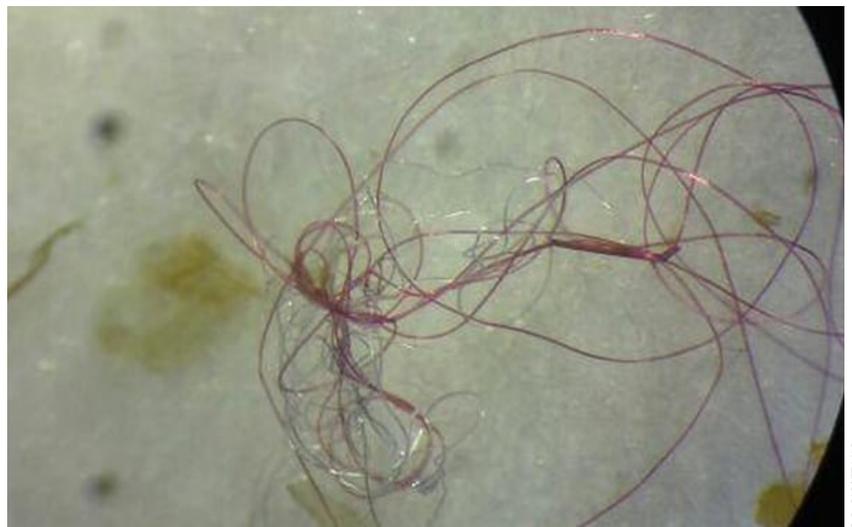
(Meeker, *et al.*, 2009 & UNEP, 2008). Relevant international expert scientific committees such as JECFA thoroughly evaluate the potential toxicity in light of newly generated scientific data. This complex evaluation process is key for risk analysis exercises (risk assessment, risk management, and risk communication). A preliminary risk assessment has been carried out by characterizing the hazards, exposure assessment and characterizing the risks.

Plastic microparticles mainly accumulate in the gastrointestinal tract of animals. Conveniently, it is a common practice to degut fish before consumption, which minimizes the direct exposure to microplastics. Nevertheless, exceptions include small pelagic fish species, such as sardines, anchovies, a number of small sized freshwater fish that are eaten whole, crustaceans (e.g. shrimps) and echinoderms (e.g. urchins). Bivalves are also of particular concern because the whole animal, including the gastrointestinal tract, is eaten. Within the bivalve group, mussels have been of great research interest. Several publications have reported the occurrence of plastic in fishery and aquaculture products but they are mainly

restricted to Europe, North America, Brazil and China. The lowest level of microplastics concentration in mussels (less than 0.5 particle/g) was reported in Europe. In contrast, the highest concentration of microplastics in mussels was observed in China, amounting to 4 particles/g (EFSA, 2016).

In order to assess the exposure to microplastics from the consumption of mussels, data about the estimated intake of mussels and the concentration of microplastics are needed. The chronic individual food consumption summary statistics (CIFOCoss) indicate that the world's top ten consumers are European countries, with the exception of China that ranks in 6th position. Not surprisingly, due to their culinary tradition, the highest reported consumption corresponds to the Belgian elderly, which is estimated to be 250g of mussels per day per person. Taking into consideration the highest reported concentration of microplastics in mussels (4 particles/g) and the highest estimated consumption, a portion of 250g of mussels could contain up to 1 000 microplastic particles, which is estimated to be approximately 9 µg, depending on the density and volume of

the particles. These values were selected in order to portray the worst case scenario and cover all the populations, especially those at greatest risk. The exposure assessment on microplastics in mussels confirmed that the estimated intake of microplastics per day is 0.15 µg/kg. For a person of 60 kg this is equivalent to 9 µg per day. The tolerable daily intake (TDI) for plastics has not yet been established; therefore it is not possible to determine if this level of exposure is in compliance with regulations. However, the TDI for some of the main plastic additives and adhered contaminants has been established; hence it is possible to revise the exposure to these compounds in mussels. The estimated intake of additives and contaminants from plastic is significantly lower than the TDI. Even in the worst case scenario it can be concluded that the intake of plastic additives (e.g. phthalates, bisphenol A, alkylphenol, and brominated flame retardants), and adhered contaminants (e.g. polychlorinated biphenyls, polyaromatic hydrocarbons, dichloro-diphenyl-trichloroethane) present in the microplastic particles ingested by aquatic organisms is negligible.



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Microfibres found inside the body of a North American fish

Concerning the fate of plastic in the human body and the possible adverse health effects, much remains unknown. It is thought that only the smallest particles (1.5 µm or less) will penetrate into the capillaries of the organs and the remaining will be excreted (Yoo, Doshi, & Mitragotri, 2011). Plastic is suspected to interact with the immune system, to cause oxidative stress and changes to the DNA (EFSA, 2016 & Brown *et al.*, 2001). Based on the available scientific evidence, it is safe to state that microplastics neither seem to pose a significant food safety threat and the health benefits associated with the intake of fishery products will exceed the potential risks. Nonetheless, there are many knowledge gaps such as toxicological data of commonly ingested plastics, the potential impact on the toxicity of microplastics of cooking or processing at high temperature, and the specific pathways for translocation, distribution and absorption of nanoplastic particles within the tissues and organs of the human body. Another important ongoing area of work is the development, standardization and harmonization of adequate analytical methods to detect nanoplastics in aquatic organisms and in the human body.



SEE ALSO

FAO. 2017. *Microplastics in fisheries and aquaculture: status of knowledge on their occurrence and implications for aquatic organisms and food safety*. Lusher, A.L.; Hollman, P.C.H.; Mendoza-Hill, J.J. FAO Fisheries and Aquaculture Technical Paper. No. 615. Rome, Italy www.fao.org/3/a-i7677e.pdf

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Plastic contamination in the oceans and inland waters is a serious problem affecting not

only the aquatic environment but also humans. Consumers should be aware that according to the current state of knowledge on the toxicity of microplastics, the risk associated with the consumption of fishery and aquaculture products contaminated with microplastics is negligible and their benefits are known to be numerous. Nonetheless, preventive and corrective measures should be taken at international, governmental and consumer levels to evaluate the toxicity of common polymers, to reduce plastic use and encourage the use of alternative materials, recycling and the adoption of sustainable practices in using plastics and managing plastic pollution.



Blue microfibers from clothing interwoven with an oyster shell

Aquaculture in Small Island Developing States

The Small Island Developing States (SIDS) are a distinct group of developing countries located in the Caribbean, the Pacific, and the AIMS region (Atlantic, Indian, Mediterranean and South China Sea), that share unique and particular opportunities, vulnerabilities and development needs¹. Food security and nutrition are priority concerns, whereas the importance of natural resources management, climate change adaptation and disaster risk reduction have been highlighted as being additional critical challenges for them to achieve their sustainable development goals.

Aquaculture may contribute to tackling some of these challenges, and this very topic will be discussed on the margins of the 2017 COFI Sub-Committee on Aquaculture held in Rome between 24th and 27th October, with the aim of formulating recommendations for the sector to support Blue Growth in SIDS through its contribution to improved economies, nutrition and food security, employment opportunities and livelihoods.

The most obvious asset for aquaculture in SIDS is their



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Community harvesting carrageenan seaweeds in East Sumba, Indonesia

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large marine environment. Moreover, the relatively high seafood consumption is another opportunity, with 70 percent of the SIDS exhibiting consumption data higher than the global 20 kg/capita/year. Moreover, the seasonal gaps in fish supply frequently create additional opportunities for aquaculture in the domestic markets. The remoteness of many islands makes fish imports expensive. On the other side, this inaccessibility also create higher costs and complexities for investors, whereas the uncertainties resulting from climate change generate new threats, as SIDS are increasingly vulnerable to external stressors such as changes in precipitation and storm activity; invasive species and the spread of aquatic pathogens; ocean

acidification; and higher water temperatures.

In 2015, the total aquaculture production of SIDS was 71 893 tonnes with a total estimated farm gate value of USD 125 million, including 50 126 tonnes of aquatic animals and 21 857 tonnes of seaweeds. Unsurprisingly, marine products dominate (seaweeds - 33 percent, and crustaceans - 15 percent, mostly shrimps), while farmed freshwater fish only play a major role in some areas with abundant inland water resource, for example Cuba. However, the aquaculture production varies greatly among countries, ranging from less than 1 tonne to around 30 000 tonnes in Cuba. In 2015, only six SIDS produced more than 1 000 tonnes (Belize, Cuba, Dominican Republic, Haiti, Papua

¹ Antigua and Barbuda, Bahamas, Bahrain, Barbados, Belize, Cabo Verde, Comoros, Cook Islands, Cuba, Dominica, Dominican Republic, Fiji, Grenada, Guinea-Bissau, Guyana, Haiti, Jamaica, Kiribati, Maldives, Marshall Islands, Mauritius, Micronesia, Nauru, Niue, Palau, Papua New Guinea, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Seychelles, Singapore, Solomon Islands, Suriname, Timor-Leste, Tonga, Trinidad and Tobago, Tuvalu, Vanuatu are SIDS/FAO member countries (www.fao.org/countryprofiles/geographic-and-economic-groups/en/).

New Guinea, and Singapore), five between 100 and 1 000 tonnes and the remaining 29 produced below 100 tonnes.

The diversity of SIDS is considerable and interventions to promote aquaculture should avoid “one-size-fits-all” solutions. Many technologies, species and systems have already been experimented and they frequently had the potential to increase islands’ income, food security and nutrition. Nevertheless, several failed, often because the development strategies have often been focused on the research and/or pilot-scale phases, leaving insufficient resources for scaling up into commercial enterprises or addressing the essential requirements of economic viability, particularly market access, market and value-chain development, and competitiveness.

Favourable outcomes in the aquaculture sector will thus require a shift in emphasis towards identifying and building comparative advantages and promoting an enabling business, policy and legal environment for private sector-led aquaculture enterprise to invest with fewer uncertainties. Stakeholders need to have access to reliable data on local profitability of aquaculture. Pilot commercial-scale operations, including research combined with business incubation and other assistance, training and education programmes may help in testing, adapting and demonstrating the economic viability of some of the technologies proposed.

Collective action and pooled resources among the SIDS through Inter-island, Inter-Regional or South-South cooperation have been identified as essential to overcoming the challenges of limited technical expertise, infrastructure, and capital

investment. Moreover, some of the challenges are also shared with some islands that do not belong to the SIDS group. The establishment of the Micronesian Association for Sustainable Aquaculture (MASA) or the Caribbean “regional shellfish hatchery” that produces native seeds to fulfil the countries’ needs are examples of such cooperation.

Finally, the Blue Economy is a new approach currently promoted for SIDS to meet the objectives laid down by the Sustainable Development Goal 14.7 (“By 2030 increase the economic benefits to SIDS and LDCs from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism”). At FAO, the Blue Growth Initiative (BGI) supports more productive, responsible and sustainable fisheries and aquaculture sectors by improving the governance and management of the aquatic ecosystems, conserving biodiversity and habitats, and empowering communities. It is currently implemented in several African SIDS including Cabo Verde, and a specific strategy is also being prepared at the Inter-Regional SIDS level.

FAO has been actively involved in supporting SIDS and during its 155th Session, the FAO Council endorsed the conclusions and recommendations of the 32nd Session of the Committee on Fisheries (COFI), stressing the need for improved aquaculture production efficiency and requesting FAO’s assistance in promoting sustainable aquaculture development in SIDS.

Examples of actions include the projects “In-depth aquaculture risk assessment and business investment planning” in several

Pacific countries (TCP/TUV/3601/C1, TCP/KIR/3602/C2, TCP/SAP/3602/C2), “Towards a Caribbean Blue Revolution” (TCP/SLC/3601), and “Adoption of efficient and climate-smart agriculture practices in African SIDS” (GCP/RAF/506/MUL).

Global aquaculture production in SIDS will likely continue to increase in the coming decades, either for improving the resilience of local communities, for generating income or both. Approaches will however need to consider the whole value chain, including market opportunities and post-harvest processing. Differences among islands are foreseen and the future performance of aquaculture will depend on its embeddedness into the local environment and on the availability of adapted production methods for species currently being farmed or of techniques for propagating and growing “new” species.



SEE ALSO

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Previous FAN's article:

Supporting Aquaculture Development in the Caribbean: Will a Regional and Shared Aquaculture Facility Work? FAN 47, June 2011 www.fao.org/docrep/014/ba0099e/ba0099e.pdf

Pacific projects updates; FAN 52, June 2014 www.fao.org/3/a-h0028e.pdf

Small-scale cage aquaculture in Mauritius. FAN 53, March 2015 www.fao.org/3/a-i4504e.pdf

Micronesian Association for Sustainable Aquaculture established. FAN 54. March 2016 www.fao.org/3/a-bc866e.pdf

Aquaculture Growth Potential: Perspective from Short-Term Projection of Fish Demand

Table – Demand-supply gaps: standard versus conservative projections

Species	Per capita demand(kg/year)		Total demand (million tonnes)		Demand-supply gap (million tonnes)		Ratio of supply growth to demand growth (%)		Annual aquaculture growth rate needed (%)		Trend aquaculture growth rate (%)
	Standard ¹	Conservative ²	Standard ¹	Conservative ²	Standard ¹	Conservative ²	Standard ¹	Conservative ²	Standard ¹	Conservative ²	
Fish	24.68	22.76	190.44	173.87	28.32	11.82	40.29	61.79	9.91	6.87	4.45
Finfish	17.31	6.08	134.55	123.65	12.67	1.82	53.11	88.76	8.42	5.36	4.81
Marine fish	8.26	7.82	64.00	59.97	10.67	6.67	4.87	7.58	40.28	30.94	3.99
Freshwater & diadromous fish	9.05	8.25	70.55	63.68	1.99	- 4.85	87.38	154.18	5.48	3.25	4.85
Shellfish	7.37	6.69	55.89	50.22	15.65	10.00	23.33	32.26	12.97	9.96	3.64
Crustaceans	2.69	2.46	20.59	18.67	5.22	3.30	27.19	37.09	14.46	11.29	4.77
Molluscs	4.68	4.23	35.30	31.54	10.44	6.70	21.24	29.59	12.29	9.35	3.13
Shell molluscs	3.95	3.56	29.88	26.61	8.61	5.36	24.63	34.43	10.89	8.22	3.13
Cephalopods	0.72	0.67	5.42	4.93	1.82	1.34			1 393.75	1 303.86	

Source: Authors' estimation.

Notes: Cells with zero or no value are left blank. ¹Standard projections are based on mean income elasticity coefficients and medium-fertility-variant population projections. ²Conservative projections are based on the lower bound of the 95 percent interval of income elasticity coefficients and low-fertility-variant population projections.

A short-term projection model has been developed to assess and monitor potential fish demand and supply gaps with the aim of facilitating evidence-based decision-making at the national, regional and global levels. The model projects the potential demand and supply gaps in nearly 200 countries or territories, about 40 regions and the entire world for nine species groups at different aggregate levels. Technical details and results are reported in the FAO Fisheries and Aquaculture Technical Paper 607, "Short-term projection of global fish demand and supply gaps". Some results are highlighted in this article.

Given that fish prices and consumer preferences remain the same, income growth would drive world per capita fish demand up from 20 kg/year in the mid-2010s to 25 kg/year in the early 2020s.

The income-driven per capita fish demand hike, combined with population growth, would drive

world fish demand up by 47 million tonnes. If aquaculture in every country follows its recent 5-year linear trend, global aquaculture production would increase by 19 million tonnes in the early 2020s. This trend aquaculture growth would cover only 40 percent of the projected demand growth, leaving a fish demand-supply gap of 28 million tonnes. The demand-supply gap for shellfish (i.e. crustaceans and molluscs) would be bigger than that for finfish – they would account for, respectively, 55 percent and 45 percent of the 28million tonnes fish demand-supply gap.

While world aquaculture production following its recent trend would grow 4.5 percent annually from the mid-2010s to the early 2020s, it would take a 9.9 percent annual growth to fill the world fish demand-supply gap in the early 2020s. Should the world aquaculture production fall short of the required annual growth rate, and assuming world capture fisheries production would remain at the current level, the world fish price would have to increase to reduce fish demand in order to clear the market (i.e. no demand-supply gap). The trend aquaculture growth in only 17 countries would be sufficient to cover the demand

growth driven by population and income growth; excess demand is expected to occur in 170 countries. More detailed results for both the standard and conservative projections are summarized in the table below.

The results of the demand-supply gap analysis are useful to decision-makers in both the public and private sectors. Knowledge and understanding of potential future fish demand as well as demand-supply gaps could facilitate the establishment of evidence-based regulations, policies and development strategies and plans, help development agencies or donors set targets and allocate resources, assist fish farmers in business planning, and guide investors in investment planning. But clear understanding of the results, including their merits and constraints, is essential to properly and flexibly using them to facilitate evidence-based decision-making.



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SEE ALSO

FAO 2017. *Short-term projection of global fish demand and supply gaps*. Cai, J. & Leung, P.S. FAO Fisheries and Aquaculture Technical Paper No. 607. Rome, Italy. www.fao.org/3/a-i7623e.pdf

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Updates on Antimicrobial Resistance

The inter-departmental FAO Working Group on Antimicrobial Resistance (AMR), chaired by FAO's Chief Veterinary Officer, meets on a regular basis and brings together FAO officers from Animal Health, Livestock Production, Codex Alimentarius, Fisheries and Aquaculture, Food Safety, Plant Health, Feed Safety, Legal and Communication and including officers from national, subregional and regional offices. Through this multidisciplinary team (Figure 1), FAO contributes to many aspects of the One Health platform.

Though antibiotic resistance genes (ARGs) have evolved naturally, indiscriminate use of antibiotics in human and animal sectors has led to selection and spread of resistant bacteria. ARGs found in aquatic systems may be derived from multiple sources such as effluents that can come from sewage, farm wastes and may be distributed through storm water. Hospital effluents carry significant pool of ARGs. Using



Figure 1 – To support the implementation of the FAO Conference Resolution 4/2015, an AMR inter-departmental working group was formed

comparative metagenomic approach, Rowe *et al.* (2016) demonstrated that the abundance of ARGs in effluents entering a river catchment area is higher than that in the receiving environment. The possible sources of ARGs entering aquatic environment and eventually aquaculture environment is illustrated in Figure 2.



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► Updates on Antimicrobial Resistance

FAO's project "Strengthening capacities, policies and national action plans on prudent and responsible use of antimicrobials in fisheries" focuses on the four pillars of the FAO Action Plan on AMR (2016-2020), as follows:

Awareness

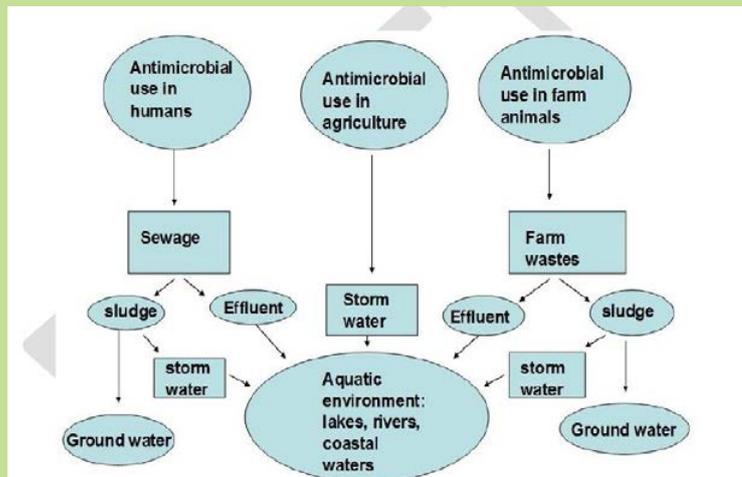
- Aquaculture component: three regional workshops on AMR and aquaculture (April, August, December 2017); National seminars and consultations; Video-clip for World Antibiotic Awareness Week (November 2017);
- Fish quality and safety component: two regional workshops (July 2017) on Fish Waste Management and Antimicrobial Residues Monitoring for Aquaculture Products and regional training on residue monitoring and AMR surveillance for fishery and aquaculture products;
- Information, education and communication (IEC) materials.

Evidence

- Antimicrobial use (AMU) and AMR surveillance of selected species (shrimp, carps, tilapia) and selected bacterial pathogens;
- Country case studies on the potential production and utilization of fish silage at country level;
- Report on antibiotic residues monitoring systems from national laboratories.

Governance

- Aquaculture component of National Action Plans on AMR developed;
- Code of Conduct for Responsible Fisheries (CCRF) Technical Guidelines on Prudent and Responsible Use of Veterinary Medicines;
- Responsible management of bacterial diseases in aquaculture;
- Session background document on AMR and aquaculture prepared for 9th Session of Committee on Fisheries Sub-Committee on Aquaculture (COFI/SCA9, October 2017, Rome) and side event on AMR during COFI/SCA9;



Karunasagar, I., 2012

Fishing operation Pathways for the spread of antimicrobial residues and resistant bacteria in the aquatic environment

- Update of the FAO Guidelines for risk-based fish inspection for including AMR aspects for fishery and aquaculture products.

Best Practice

- IEC materials on best practice for shrimp, tilapia and carps;
- Guidance on antibiotic susceptibility testing for aquaculture and aquaculture products;
- Technical manual on fish waste management (production and utilization of fish silage).



SEE ALSO

Karunasagar, I. 2012. *Public health and trade impact of antimicrobial use in aquaculture*. In M.G. Bondad-Reantaso, J.R. Arthur & R.P. Subasinghe, eds. *Improving biosecurity through prudent and responsible use of veterinary medicines in aquatic food production*, pp. 1-9. FAO Fisheries and Aquaculture Technical Paper No. 547. Rome, FAO. 207 pp.
www.fao.org/docrep/016/ba0056e/ba0056e.pdf

Rowe, W., Verner-Jeffreys, D.W., Baker-Austin, C., Ryan, J.J., Maskell, D.J. and Pearce, G.P. 2016. *Comparative metagenomics reveals a diverse range of antimicrobial resistance genes in effluents entering a river catchment*. *Water Sci. Technol.* 73: 1541–9.



Harvesting of Indian major carps

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Summary of the National Aquaculture Legislation Overview (NALO) of Morocco



Continental aquaculture in Morocco has been knowing a steady growth trend, production increased from 2 500 tonnes in 2005 to 15 000 tonnes in 2014, as a result of the implementation of the strategic plan 2005-2014 for the development of fisheries and fish farming in continental waters. Marine aquaculture is still in the early stages of development and it approximately reaches 500 tonnes per year, compared to 1 million tonnes from capture fisheries.

The Department of Maritime Fisheries (DPM) of the Ministry of Agriculture and Fisheries is the authority in charge of developing and implementing the Government's policy on fisheries and aquaculture. The National Agency for the Development of Aquaculture (ANDA) is in charge of promoting and developing aquaculture. The National Research Institute in Fisheries (INRH) is in charge, inter alia, of monitoring the safety of fishery and aquaculture products and undertakes studies and research. Finally, the National Food Safety Authority (ONSSA) is the authority responsible for the sanitary approval of aquaculture farms through monitoring plans and the certifications of products placed on the market. The Maritime Fisheries Chambers act as an advisory body for the government for all matters related to aquaculture and the exploitation of coastal fisheries resources.

To establish and operate an aquaculture activity, the current

legal framework provides for an obligation to apply for a license in advance, accompanied by a draft of a concession agreement, to the competent services under the governmental authority in charge of fisheries. The granting of a license is subject to an Environmental Impact Assessment. The Ministry of environmental affairs created a national committee and regional environmental impact assessment committees in charge of advising on the environmental acceptability of projects.

Artificial accumulation of water is subject to authorization when above 200 thousand cubic meters. The application for authorization shall be addressed to the Director of the hydraulic basin agency. Authorization for the use of water may be obtained after a public inquiry, by authorization, or by concession issued by the Ministry of Public Works and Logistics. Regarding the water public domain, authorizations of occupation for the creation and the operation of an aquaculture farm are issued by the Agencies of the Hydraulic Basins currently under the Ministry Delegate to the Minister of Energy, Mines, Water and Environment, in charge of water.

At present, Morocco does not have a specific legislation on spatial planning for aquaculture. However, Urban Planning Master Plans and Municipal Planning Plans have a legal basis and concern all activities on land. A *draft law* laying down the Marine Aquaculture Code is currently being considered by the Parliament. It shall provide a legal definition of aquaculture, which is still missing from the current legal framework, and shall define new rules for the planning, development and management of marine aquaculture that are more in line with international aquaculture standards.

The discharge of dangerous substances is prohibited or subject

to authorization by the public administration. In the case of maritime areas and resources under national sovereignty or jurisdiction, provisions must be made, inter alia, to terminate or prevent activities which may affect the quality of maritime waters and resources. Measures for the prevention and control of maritime pollution and criteria for the classification of particularly protected areas are laid down in the law.

Food safety in aquaculture is regulated by a number of laws and regulations establishing general principles of food safety for foodstuffs and feed. The law states, inter alia, that freshwater and sea products for import - with the exception of those on international transit without breaking bulk - are subject to a sanitary and qualitative control, at the expense of the importer. The health of aquatic organisms is regulated by the provisions of a *Dahir* (Decree) and several Ministerial Orders, which establish a list of reportable diseases for aquaculture fish and molluscs, as well as veterinary sanitary measures for prevention and eradication purposes.

In addition to the legal provisions, the ANDA has developed a procedure manual made available to investors on the ANDA website (www.anda.gov.ma). This manual provides guidance on the steps to be undertaken in order to carry out an aquaculture project, as well as the different stages of processing applications for authorization to set up and operate aquaculture farms.



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NEW STAFF PROFILES



Ana Menezes

*Aquaculture Officer,
Aquaculture Branch*

Ana, who was transferred from Addis Ababa, Ethiopia to FAO Headquarters in Rome, worked as the Fisheries and Aquaculture Officer of sub-regional Office for Eastern Africa (SFE) from October 2012 to August 2017. She brings an extensive knowledge of Aquaculture and Fisheries development in Africa. As a sub-regional officer, she has been assisting the FAO representations and government partners with the planning, development, implementation and evaluation of fisheries and aquaculture projects. Her main objective in the Sub-Saharan Africa was to promote the development of aquaculture from subsistence to commercially responsible, and under the ecosystem based approach, by targeting the main market failures and improving the accessibility of farmers to quantity and quality of feeds, seeds, market and knowledge sharing.

Prior to FAO, she worked with the United Nations Environment Programme (UNEP) in the Policy Division based in Mozambique as a UNEP National Officer focusing on Climate change in semi-arid lands. She equally served in her capacity as the UNEP delegate for the United Nations Country Team (UNCT) from 2009 to 2012. From 2000 to 2004, she served as the Environmental Liaison Officer for the Agriculture Donor Working Group. From 1987 to 2000, she worked for the government of Mozambique as an aquaculture research officer and later appointed as National Director of Research and Planning for the Ministry of Environmental Affairs.

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Image of women reflected in a fish pond, Algeria

©FAO/V. CRESPI



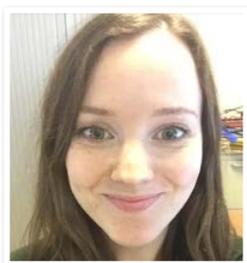
Anne Fadilla Rachmi

Intern, Aquaculture Branch

Anne a Malaysian national, obtained her bachelor degree from Bandung Institute of Technology, Malaysia, in 2016, majoring bioengineering. In the last year on her study in university she worked on two projects, the first is preliminary design of lycopene production system from cherry tomato and the second is the research about effect of spectrum and light intensity toward the productivity of lycopene and β -carotene in cherry tomato. Previously, she volunteered in one of Indonesia NGO for training peasant, fisher, and workers about transformative social protection. After her internship, she will continue her master study and pursue her career in aquaculture field, she interested to do research in marine culture and climate change effect on that practices.

During her six months internship she will work for developing and finalizing WAPI (World Aquaculture Performance indicators) tools also write the user guide on production module under Dr Junning Cai supervision. At the end of September she will be presenting and demonstrating the tools.

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Kathleen Allen

Intern, Aquaculture Branch

Kathleen a Canadian national, recently joined the Aquaculture Branch as part of a 6 month internship. She obtained a bachelor degree in biology and history (2014) and a master's degree in biology (2016) from Queen's University in Kingston, Canada. Her undergraduate and graduate research focused on tilapia nutrition and was presented at the 2014 World Aquaculture Conference in Las Vegas. She has also researched tilapia breeding, rainbow trout nutrition, recirculating aquaculture systems, and aquaponics systems.



Daniela Lucente

Consultant, Aquaculture Branch

Daniela, an Italian National, is a Biologist. She obtained a Master's Degree in Biodiversity and Ecosystems Management from Roma Tre University, Italy, where she started to acquire her experience in the field of evolutionary biology and population genetics. In 2014, she obtained a Doctoral Degree in Ecology and Management of the Biological Resources from Tuscia University. She continued to work in Tuscia University for the following three years as a postdoctoral fellow on projects mainly funded by the Italian National Institute for Environmental Protection and Research (ISPRA) and the National Program for Antarctic Research (NPAR). Her scientific studies have dealt with phylogenetics, population genetics and evolutionary immunology of different animal groups.

In March 2017, she joined to the Aquaculture team of the FAO Fisheries and Aquaculture Department as a consultant. One of her major goal in FAO is to contribute to the development of a Framework that FAO Members can use to identify a set of minimum criteria for a sustainable use and management of their aquatic genetic resources in aquaculture.

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Kathleen has worked with the Ontario Ministry of Agriculture, Food and Rural Affairs (a provincial government body), under the supervision of their Aquaculture and Aquaponics specialist. In her role, she helped assess prospective aquaculture species for approval, consulted with current and prospective aquaculture and aquaponics producers, and liaised with First Nations stakeholder groups. Kathleen has also worked in the private sector where she was the Sustainable Seafood and Animal Welfare Specialist at Metro Richlieu Inc. (a Canadian food retailer). In this position, she updated the retailer's sustainable seafood and animal welfare policies, conducted research on seafood and animal welfare certification schemes, represented the company at industry and stakeholder meetings, and evaluated the sustainability claims of new and existing products and suppliers.

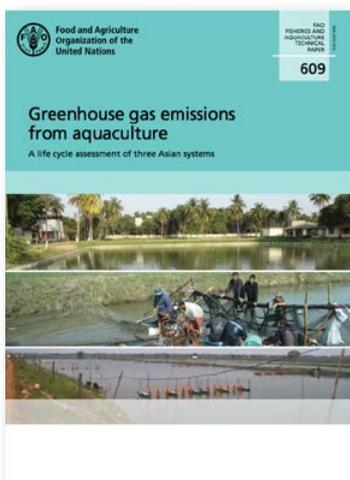
During her time with FAO, Kathleen will be working on developing the World Aquaculture Performance Indicators (WAPI) consumption module.

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NEW PUBLICATIONS

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TECHNICAL PAPERS



FAO. 2017

Greenhouse gas emissions from aquaculture: a life cycle assessment of three Asian systems.

Robb, D.H.F., MacLeod, M., Hasan, M.R. & Soto, D. FAO Fisheries and Aquaculture Technical Paper No. 609. Rome, Italy. FAO. 110 pp.

This technical paper was prepared as a part of the FAO's Strategic objective (SO2): Increase and improve provision of goods and services. The rationale of this study is to broaden the understanding of aquaculture's contribution to greenhouse gas emissions (GHG) and the potential mitigation through the management of aquaculture feeds and feeding. This study was carried out on three aquaculture systems: Nile tilapia in Bangladesh, Indian major carps in India and striped catfish in Viet Nam in order to estimate the possible scale of greenhouse gas emissions in aquaculture in Asia. The analysis was intended to improve the understanding of where and how GHG emissions arise in Asian aquaculture, whilst highlighting weaknesses in the currently available data. The results of this study will guide future studies on where to improve the data and on how to develop cost-effective ways of improving aquaculture performance and reducing emissions. This report highlights the variation within each farming system at every stage of the three Asian aquaculture systems. The report makes some suggestions for methods, which potentially could reduce emission intensities related to the farming systems, but applying best practices uniformly on farms and thus increasing efficiencies appear to be major factors for improvement.

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

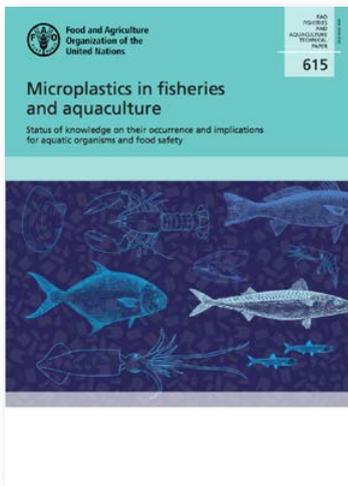
www.fao.org/3/a-i7558e.pdf

For further information, please contact: Mohammad.Hasan@fao.org



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Stripping eggs from female tilapia, St. John's, Antigua



FAO. 2017

Microplastics in fisheries and aquaculture: status of knowledge on their occurrence and implications for aquatic organisms and food safety

Lusher, A.L.; Hollman, P.C.H.; Mendoza-Hill, J.J. FAO Fisheries and Aquaculture Technical Paper. No. 615. Rome, Italy

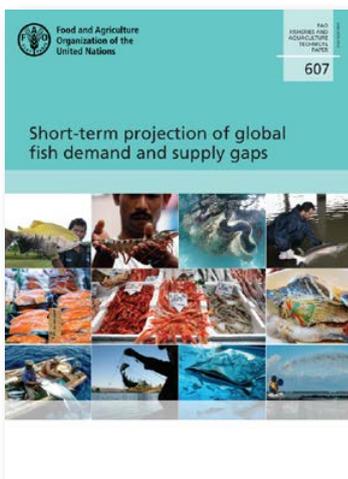
Plastic production has increased exponentially since the early 1950s and reached 322 million tonnes in 2015, this figure does not include synthetic fibres which accounted for an additional 61 million tonnes in 2015. It is expected that production of plastics will continue to increase in the foreseeable future and production levels are likely to double by 2025. Inadequate management of plastic waste has led to increased contamination of freshwater, estuarine and marine environments. It has been estimated that in 2010 between 4.8 million to 12.7 million tonnes of plastic waste entered the oceans.

This technical paper contributes to take stock of the scientific knowledge available on microplastics in fisheries and aquaculture. It provides information on the most likely pathways in terms of sources, transport and distribution in both marine food chains and seafood value chains and provides a framework to assess the risks that may (or not) affect commercial fish stocks and consumers, as well as review current practices and limitations of microplastic sampling techniques.

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

www.fao.org/3/a-i7677e.pdf

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FAO. 2017

Short-term projection of global fish demand and supply gaps

Cai, J. & Leung, P.S. FAO Fisheries and Aquaculture Technical Paper No. 607. Rome, Italy

A short-term projection model is developed to assess and monitor potential future fish demand and supply gaps at the country (nearly 200 countries or territories), regional (about 40 country groups), and global levels for nine species groups. The results indicate that: (i) if fish prices and consumer preferences remain the same, income growth would drive world per capita fish demand up from 20 kg/year in the mid-2010s to 25 kg/year in the early 2020s (or 23 kg/year under the conservative projection); (ii) the income-driven per capita fish demand hike, combined with population growth, would drive world fish demand up by 47 million tonnes (or 31 million tonnes under the conservative projection); (iii) the 19-million-tonne fish supply growth generated by the trend growth of world aquaculture production would cover only 40 percent of the projected demand growth (or 62 percent of the conservative projection), leaving a fish demand-supply gap of 28 million tonnes (or 16 million tonnes under the conservative projection) in the early 2020s; (iv) the demand-supply gap for shellfish (i.e. crustaceans and molluscs) would be bigger than that for finfish – they would account for, respectively, 55 percent and 45 percent of the 28-million-tonne fish demand-supply gap; (v) while world aquaculture production following its recent trend would grow 4.5 percent annually from the mid-2010s to the early 2020s, it would take a 9.9 percent annual growth (or 6.9 percent under the conservative projection) to fill the world fish demand-supply gap in the early 2020s. Salient results at the global, regional and country levels are presented in the main text. Key results for all countries and all the nine species groups (including both standard and conservative projections) are documented in the appendix.

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

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FAO. 2017

Planning for aquaculture diversification: the importance of climate change and other drivers

Harvey, B., Soto, D., Carolsfeld, J., Beveridge, M. & Bartley, D.M. eds. FAO Technical Workshop, 23–25 June 2016, FAO Rome. FAO Fisheries and Aquaculture Proceedings No. 47. Rome, Italy FAO. 166 pp.

Aquaculture continues to grow as an important source of food, as both wild fisheries reach their limits or are declining, and the demand for fish increases. Diversification is a key element of this growth, in terms of species or strains farmed, technologies and areas being used for farming, and products and markets. The workshop described in this volume examined the process of diversification, in its various forms and in the contrasting cultural and socio-economic situations of different continents, asking the question if the diversification process is or can help meet the challenges of increasing impacts of climate change. The evaluation led to several conclusions and recommendations.

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

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FAO. 2017

Report of the FAO Expert Workshop on Sustainable Use and Management of Artemia Resources in Asia. Tianjin, China, 7–9 November 2016

FAO Fisheries and Aquaculture Report No. 1198, Rome, Italy

The FAO Expert Workshop on 'Sustainable Use and Management of Artemia Resources in Asia' was convened in Tianjin, China, from 7–9 September 2016. The objective of this workshop was to bring together a critical amount of key people, active in the field of Artemia biological research, exploitation or use, with as ultimate goal to define the organisational structure for the sustainable management of the Artemia resources in China, both inland and coastal, and their optimal use in aquaculture. The participants attended a variety of presentations related to (1) History of Artemia study and use; (2) Artemia biodiversity and sustainable management of Artemia resources; (3) Contribution of Artemia in biological and medical research; and (4) Application of Artemia in aquaculture in the first day of the workshop. During the second day a field trip was organised to visit Artemia pond culture and cyst processing centre, and to a number of aquaculture facilities. The third day was entirely dedicated to plenary discussions and following the general plenary discussion, the participants identified a number of recommendations in order to stimulate the use of Artemia as an aquaculture commodity, its study as an element of biodiversity and its use as biological model organism. The recommendations addressed the need for the establishment of an Asian Regional Artemia Reference Centre (AR-ARC) in China within the immediate future, the agreement that TUST is well-positioned to host this AR-ARC in view of its track record and expertise in Artemia studies, and the participants' commitment to support the establishment, organisation and functioning of the AR-ARC. A number of actions were proposed, related to the internal organisation and external linkage of the AR-ARC, and short- and mid-term deliverables, to be produced by the AR-ARC.

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

www.fao.org/3/a-i7432e.pdf

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FAO. 2017

Report of the Workshop on Climate Proofing Aquaculture in sub-Saharan Africa: Review of Policies and Production Systems for Climate Change Resilience. Addis Ababa, Ethiopia, 9–10 June 2016

FAO Fisheries and Aquaculture Report No. 1201. Rome, Italy.

Regionally across Sub-Saharan Africa, aquaculture is a rapidly growing industry with its practices and operations increasingly more commercialized across the continent. An estimated six-fold production increase, from 55 690 tonnes in 2000 to 359 790 tonnes in 2010 was recorded. This trend is expected to increase as the continent's aquaculture operations develops and industrializes. This inevitable production increase and consequent intensification will predominantly be based on fossil fuels. The Norwegian Ministry of Foreign Affairs and the FAO have entered an agreement to improve the implementation and management of existing critical climate change gaps. The series of projects aims to improve global understanding of climate change impact on fisheries and aquaculture development and highlight regional climate change adaptation measures taken on food systems and food security across the African region. Together, the Consortium of International Agricultural Research Center's WorldFish and the FAO Regional Office for Africa (Accra, Ghana) have conducted an assessment of the region's aquaculture development and climate change impact adaptation status under two project scopes: (i) a policy review; this component presents a diagnosis of the existing/non-existing African climate change policies related to aquaculture, the sector's resiliency and aims to lay bare a regional overview. (ii) a vulnerability assessment model exercise; this exercise utilizes numerous datasets (i.e. meteorological, aquaculture, and socio-economic variables) and inputs from country representative deliberations from a validation workshop. The process highlighted what was required at the national level to make more realistic and conclusive assessments for tangible adaptation policies. Together, the policy review and the vulnerability assessment tool demonstrated the required country level actions necessary to prioritize action areas to develop and put in place climate change impact strategies.

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

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FAO. 2017

Report of the tenth session of the Scientific Advisory Committee on Aquaculture

General Fisheries Commission for the Mediterranean Report No. 1206. Izmir, Turkey, 27–29 March 2017. 75 pp.

The Scientific Advisory Committee on Aquaculture (CAQ) of the General Fisheries Commission for the Mediterranean (GFCM) held its tenth session in Izmir, Turkey, from 27 to 29 March 2017. The session was attended by delegates and representatives from 13 contracting parties and 2 cooperating non-contracting parties, 2 observers from intergovernmental organizations and representatives from the Food and Agriculture Organization of the United Nations (FAO) and the GFCM Secretariat. The agenda also included the fifteenth session of the Information System for the Promotion of Aquaculture in the Mediterranean (SIPAM), which was organized concomitantly. During the session, the Committee reviewed the work carried out during the 2015–2017 intersession. In particular, the CAQ discussed aspects related to i) its reorganization; ii) the finalization of guidelines on a harmonized environmental monitoring programme (EMP) for marine finfish cage farming; iii) preparatory work on guidelines to streamline aquaculture licensing and leasing processes; iv) finfish and shellfish aquaculture industry and market, including a collection of success stories; and v) the status of aquaculture multi-stakeholder platforms in the region. Moreover, the Committee examined the contents of a draft strategy for the sustainable development of Mediterranean and Black Sea, developed by a dedicated Task Force, and agreed to keep working towards its finalization so that it could be submitted to the next session of the Commission, given the key role to be played by this strategy in efficiently addressing current and emerging challenges facing the sustainable development of aquaculture in the Mediterranean and the Black Sea. The Committee then formulated advice in order to steer future work on aquaculture market and industry, aquaculture licensing and leasing processes, aquaculture and environment and aquaculture multi-stakeholder platforms and within the framework of the SIPAM. Finally, the Committee agreed upon its work plan for 2017–2018 and elected its new Bureau.

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FAO. 2017

Social and economic performance of tilapia farming in Africa

Edited by J. Cai, K.K. Quagrainie and N. Hishamunda. FAO Fisheries and Aquaculture Circular No. 1130. Rome, Italy

World tilapia aquaculture production grew 12 percent annually, from less than a half million tonnes in the early 1990s to over 5 million tonnes in the mid-2010s. Africa accounted for 20 percent of the growth. Yet most of the contribution came from Egypt, whereas in the mid-2010s countries in sub-Saharan Africa accounted for less than 20 percent of tilapia aquaculture production in Africa and less than 4 percent of the world production. In light of the potential fish demand driven by population and economic growth in Africa where tilapia is a native species favoured by most consumers, there is little doubt that there is great potential for the development of tilapia farming in Africa and in sub-Saharan Africa in particular. However, an appropriate development policy and sector management are needed to realize the potential. This collective volume includes five studies on tilapia farming in Egypt, Ghana, Kenya, Nigeria and Uganda, which together accounted for nearly 95 percent of Africa's tilapia aquaculture production in the mid-2010s. Each study provides a comprehensive account for the development of tilapia farming in the respective country with focus on the social and economic dimensions. Tilapia value chains are analysed in the context of the entire aquaculture or fish value chains from various perspectives (e.g. technical, economic, social and institutional). Issues, constraints and challenges are highlighted and discussed. Potential solutions are recommended. Despite the vast information and knowledge provided by the studies, there are still many unknowns about tilapia farming in Africa, especially on the economic performance. Further study is needed to fill the information and knowledge gaps.

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

www.fao.org/3/a-i7258e.pdf

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FAO. 2017

Fishery and aquaculture insurance in China

Prepared by Yuan Xinhua, Tipparat Pongthanapanich, Zhang Zongli, Jing Xiaojun & Ming Junchao. FAO Fisheries and Aquaculture Circular No. 1139, Rome, Italy.

This document reviews the history, organization and implementation mechanisms, policy development and innovations in fisheries and aquaculture insurance in China. With 25 years of practice, fisheries insurance in China has contributed significantly to risk management. It provides compensation for economic loss, life loss and medical expenses of injury, particularly heavy economic loss caused by disasters. The cases studies are of those of capture fishery mutual and finfish, crab, shrimp and seaweed farming. The development status, insurance scheme and performance evaluation are documented. The pilot programmes received technical support from professional associations and cooperatives, as well as professional service from commercial insurance companies. Aquaculture insurance will take some time to satisfy the increasing demand of marine and freshwater aquaculture farmers. Suggestions on legal, organization, mechanism in catastrophe relief, and mutual insurance operation were provided.

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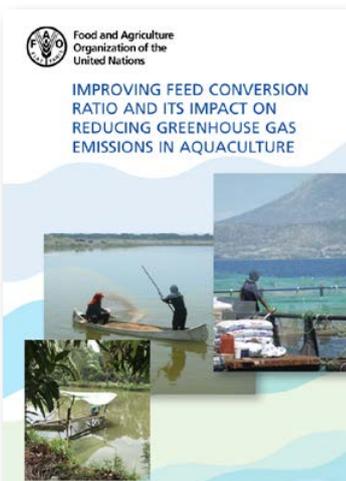
www.fao.org/3/a-i7436e.pdf

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Happy harvest of Indian carps, Bangladesh

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FAO. 2017

Improving feed conversion ratio and its impact on reducing greenhouse gas emissions in aquaculture

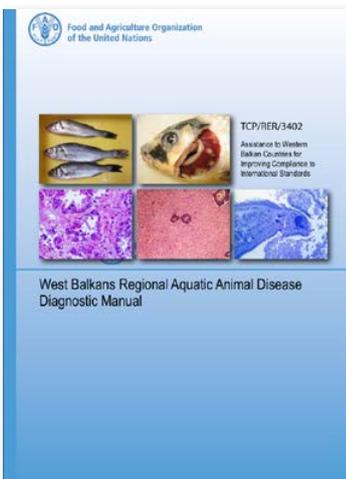
Hasan, M.R. & Soto, S. FAO Non-Serial Publication. Rome, Italy. FAO. 33 pp.

This FAO Non-Serial Publication presents a narrative report of an FAO/GSI workshop held in Liberia, Costa Rica including the conclusion and recommendations, summaries of technical presentation given at the workshop, a compendium of the PowerPoint presentations made in workshop, and an excel-based greenhouse gas tool for quantifying greenhouse gas emissions arising from aquaculture. The rationale of this study undertaken was to i) assess the current GHG contributions of aquaculture, related to feeds and feeding, and understand ways to measure it; ii) explore current potential for reducing feed conversion ratio (FCR) for a range of important and commercially significant species, and therefore continuing to improve their environmental performance including reductions in GHG and iii) explore potential transfer of feed and feeding technologies and lessons learnt from the well-developed salmon farming industry to other freshwater and marine species such as carps, catfishes, tilapia and shrimps. The findings of this study identified several factors that impact FCRs, particularly in species farmed in developing countries, which could be targeted with programs that ultimately would reduce GHG and other emissions. The study concluded that managing environmental aspects, simplifying farm management through improved farm monitoring systems, and improving feed management, would improve FCRs and reduce GHG emissions.

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FAO. 2017

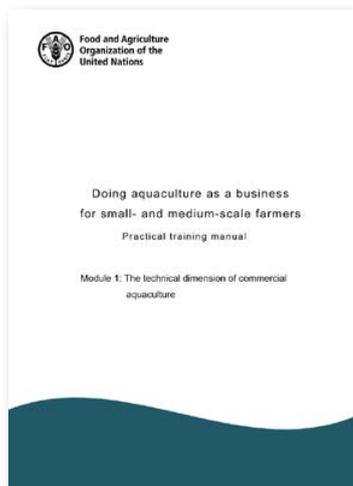
West Balkans Regional Aquatic Animal Disease Diagnostic Manual (FAO TCP/RER/3402). Zrnčić, Snježana and Radosavljević, Vladimir. Rome, Italy. FAO. 100 pp.

This West Balkans Regional Aquatic Animal Disease Diagnostic Manual is a handbook whose main purpose is to facilitate the daily duties at aquaculture farms and provide a useful reference that will answer the majority of practical questions posed by official veterinarians, veterinary inspectors and fish health experts in five Western Balkan countries (Bosnia and Herzegovina, the Republic of Croatia, The former Yugoslav Republic of Macedonia, Montenegro and the Republic of Serbia). This is a diagnostic guide for the surveillance, clinical inspection and sampling at aquaculture facilities with the aim to detect the diseases listed by the World Organization for Animal Health (OIE) and the European Union (EU) according to their guidelines and standards, as well as other diseases of economic importance. The manual provides essential information on how to perform clinical inspections of fish and mollusc farms, how to recognize unusual behaviour of fish; how to select the most appropriate specimens for laboratory examination; and how to collect, pack and ship samples to the diagnostic laboratory. The laboratory procedures employed to identify the various disease agents are described, and information on the viral, bacterial and parasitic diseases of fish and molluscs in the Western Balkans is provided. The information presented should assist countries to maintain and improve their national aquatic animal health status, harmonize standards regionally, and better comply with the health standard requirements of regional and international trading partners.

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FAO. 2017

Doing aquaculture as a business for small- and medium-scale farmers. Practical training manual. Module 1: The technical dimension of commercial aquaculture

Prepared by Ana Menezes, Nathanael Hishamunda, Leonard Lovshin and Elisabetta Martone. Addis Ababa, Ethiopia; Rome, Italy. 53 pp.

The “Practical Training Manual on Doing Aquaculture as a Business for Small and Medium-Scale farmers” is composed by two modules: Module 1 “The Technical Dimension of Doing Aquaculture as a Business” and Module 2 “The Economic Dimension of Doing Aquaculture as a Business”. The target users of both modules are small and medium-scale fish farmers. The purpose of this module is to enhance small and medium-scale fish farmers’ knowledge and capacities in understanding and applying the basic technical principles and concepts of doing aquaculture as a business in their daily activities. Module 1 introduces the factors affecting primary productivity, carrying capacity, growth rate and yield in water, the general criteria for classifying the aquaculture systems and the main features of pond and cage based fish farming systems. The concepts of seed production, nutrition and feeds and harvest and post-harvest practices are also introduced.

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

www.fao.org/3/a-i7461e.pdf

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FAO. 2017

Granjas agro-acuícolas demostrativas: sistematización de un programa para fortalecer las capacidades de acuicultores de recursos limitados

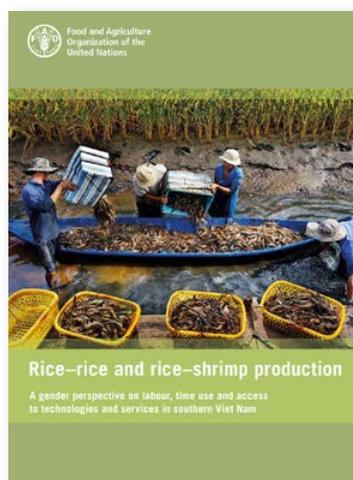
Flores-Nava, A.; D. Mendoza; M. Castro and R. Andrade. Oficina Regional de la FAO para América Latina y el Caribe, Santiago del Chile, Chile. 68 pp.

El presente documento es el producto del trabajo de integración de resultados del Programa Regional de Construcción y Operación de Granjas Agro-Acuícolas Demostrativas, desarrollado en el marco del proyecto GCP/RLA/190/BRA, cuyo objetivo primario fue fortalecer las capacidades de los acuicultores de recursos limitados (AREL) y los acuicultores de la micro y pequeña empresa (AMyPE) en países seleccionados de América Latina y el Caribe (Antigua y Barbuda, Colombia, Costa Rica, Guatemala y Paraguay).

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FAO. 2017

Rice-rice and rice-shrimp production: a gender perspective on labour, time use and access to technologies and services in southern Viet Nam

Prepared by Flavia Grassi, Thelma R. Paris, Truong Thi Ngoc Chi

Within the framework of supporting sustainable production in a context of rural transformation, this study focuses on smallholder farms in Soc Trang, southern Viet Nam. Its purpose is to highlight and compare women and men’s contributions to two integrated, rice-based farming systems and explore how gender norms affect labour and access to productive inputs, technologies and services: the first is a more traditional production system centered on double rice cropping, while the second adopted an innovative practice which integrates rice and aquaculture (shrimp farming). The conclusion introduces a set of key findings and research, policy and project implementation recommendations.

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

www.fao.org/3/a-i7277e.pdf

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FAO. 2017

FAO Second International Technical Seminar/Workshop on Acute hepatopancreatic necrosis disease (AHPND): There is a way forward!
 FAO Technical Cooperation Programme: TCP/INT/3501 and TCP/INT/3502.

Outbreaks of acute hepatopancreatic necrosis disease (AHPND), commonly known as "early mortality syndrome" (EMS), caught the entire shrimp industry, the academe and the government sectors by surprise, and it took a long while to unravel its mystery because the disease broke through all biosecurity measures. While the industry has been dealing with vibriosis in all phases of culture for decades, nobody thought that a *Vibrio* would become an industry game-changer. The disease calls for a combination of basic, new and innovative strategies in biosecurity and control, and since the pathogen is ubiquitous in the environment, an exclusion strategy may not be possible. Sharing the responsibility among the government, academe and producer sectors has become essential. The "First International Technical Seminar/Workshop: EMS/AHPND - Government, scientist and farmer responses" was held in Panama City from 22-24 June 2015. The "Second International Technical Seminar/Workshop on AHPND: There is a way forward" was held in Bangkok from 23-25 June 2016. The Bangkok AHPND 2016 is also the 3rd international event organized by FAO on EMS/AHPND; the first one was held in Hanoi, Viet Nam from 25-27 June 2013 (Hanoi EMS/AHPND June 2013, see www.fao.org/docrep/018/i3422e/i3422e00.htm). This document presents the abstracts of presentations delivered in Bangkok in June 2016.

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

www.fao.org/3/a-bt131e.pdf

For further information, please contact: Melba.Reantaso@fao.org



Nutritious products (fish and vegetables) from an aquaponics facility in St. John's, Antigua

CALENDAR OF EVENTS



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SEPTEMBER 2017

FAO Regional Meeting on Agricultural Biotechnologies in Sustainable Food Systems and Nutrition in Asia-Pacific

*Kuala Lumpur Convention Centre (KLCC), Kuala Lumpur, Malaysia, 11-13 September 2017,
www.fao.org/about/meetings/agribiotechs-symposium/en/*

Information: Melba.Reantaso@fao.org

FAO Regional Training and Verification Workshop on Technical Guidelines for Innovative Rice-Fish farming and Climate Resilient Tilapia Culture in Asia-Pacific

Bangkok, Thailand, 12-14 September 2017

Information: Weimin.Miao@fao.org

Vigo Dialogue on Decent Work in Fisheries and Aquaculture

Vigo, Spain 03 October 2017

Information: Uwe.Barg@fao.org

Epizootic Ulcerative Syndrome Surveillance Data Analysis Workshop

(under FAO/ African Solidarity Trust Fund Project "Strengthening controls of food safety threats, plant and animal pests and diseases for agricultural productivity and trade in Southern Africa"), Kasane, Botswana, 4-6 October 2017

Information: Melba.Reantaso@fao.org

End of Project Workshop of the FAO/African Solidarity Trust Fund Project

"Strengthening controls of food safety threats, plant and animal pests and diseases for agricultural productivity and trade in Southern Africa," Victoria Falls, Zimbabwe, 9-12 October 2017

Information: Melba.Reantaso@fao.org

Second Session of the COFI Advisory Group on Aquatic Genetic Resources and Technologies

Rome, Italy, 19-20 October 2017

Information: Matthias.Halwart@fao.org

Ninth Session of the Committee on Fisheries (COFI) Sub-Committee on Aquaculture

Rome, Italy, 24-27 October 2017

Information: Matthias.Halwart@fao.org

OCTOBER 2017

NOVEMBER 2017

Final Workshop of the FAO project TCP/INT/3501: Strengthening biosecurity governance and capacities for dealing with the serious shrimp infectious myonecrosis virus (IMNV) disease*Qingdao, China, 2-5 November 2017**Information: Melba.Reantaso@fao.org***FAO/APFIC Regional Consultative Workshop: Building Climate Resilient Fisheries and Aquaculture in Asia-Pacific.***Bangkok, Thailand, 14-16 November 2017**Information: Weimin.Miao@fao.org***FAO Regional Expert Meeting: The Use of Antimicrobials in Aquaculture in Latin America: Challenges and Future Perspectives***Lima, Peru, 22-24 November 2017**Information: Alessandro.Lovatelli@fao.org*

DECEMBER 2017

FAO Regional Dissemination Workshop on Piloting of Aquaculture Planning and Management Tools*Batam, Indonesia, 5-7 December 2017**Information: Weimin.Miao@fao.org***Final Workshop of the FAO project FMM/RAS/298: Strengthening capacities, policies and national action plans on prudent and responsible use of antimicrobials in fisheries.***Guangzhou, China 12-14 December 2017**Information: Melba.Reantaso@fao.org***NON FAO EVENTS**

OCTOBER 2017

CONXEMAR, Vigo, Conference and exhibition*Vigo, Spain 2-5 October, 2017**Information: Audun.Lem@fao.org***OECD Innovation for a Sustainable Ocean Economy: Linking economic potential and marine ecosystem health through innovation***Naples, Italy, 10-11 October 2017**Information: Malcolm.Beveridge@fao.org*AUGUST
2018**AQUA 2018 #WeRAquaculture, The Joint EAS-WAS Conference***Montpellier, France, 25-29 August 2018*www.was.org/meetings/default.aspx?code=Aqua18*Information: Lionel.Dabbadie@fao.org*SEPTEMBER
2018**Global Conference Tenure and User Rights in Fisheries 2018: Achieving Sustainable Development Goals by 2030 (User Rights 2018)***Busan, Republic of Korea, 10-14 September 2018**Information: Rebecca.Metzner@fao.org*

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The Food and Agriculture Organization of the United Nations (FAO) Fisheries and Aquaculture Department has published an aquaculture photo library where photographs taken by FAO aquaculture officers and consultants working in the field are stored. The main goal of the photo library is to make available to internal and external users photos focusing on global practices of aquaculture. This Web representation is not to be considered as a final static product, but will continuously be revised and updated through inputs provided by the users. This online photo library is especially addressed to extension services, aquaculture research centres and educational institutes that can use the photo library to learn more on aquaculture by means of a visual approach.

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Courtesy of FAO Aquaculture Photo Library.

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Laindunga Seaweed Community - Seaweed farmers carrying seaweed seedlings

Year
2016

Author(s) (N. Surname)
M. Ledo

Keywords
Seaweed

Locality
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Contact us: Users who would like to contribute to this initiative are invited to send their original photos focusing on aquaculture to FAO by writing to: Valerio Crespi (Aquaculture Branch). E-mail address: Valerio.Crespi@fao.org

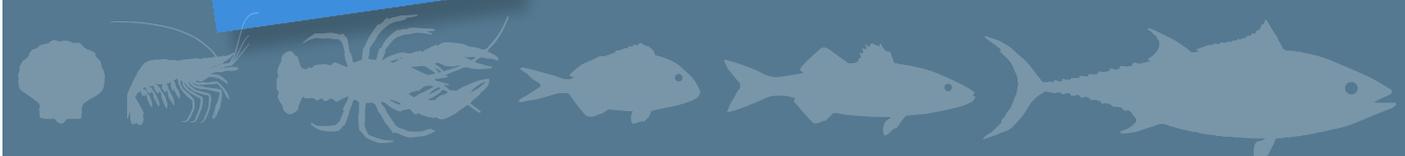
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