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FAO Aquaculture News

In this month's issue

EDITORIAL

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Keep on swimming

Dear reader,

This edition of *FAN* comes nearly two years after the Coronavirus disease 2019 outbreak. First reported in late 2019, it quickly escalated into a global pandemic by mid-March the following year. Two years of uncertainty and disruptions, two years of lost loved ones, lost jobs and lost time. But, as always, life continues. And, as always, we ate fish. Grilled or poached, sautéed or fried, steamed or baked or even raw: thousands of millions of seafood meals were served around the world by families eating finfish and clams, mussels and crabs, shrimp and seaweed in countless dishes prepared with innumerable recipes.

Who supplied all the fish and all the aquatic foods that we ate? It was the twenty million fishers and fish farmers around the world producing it. A majority of these producers are small-scale, artisanal fishers and aquaculture workers, which is one reason why 2022 is so special, for it is the International Year of Artisanal Fisheries and Aquaculture, or IYAFA.

Designated by the United Nations General Assembly to celebrate these people and their contribution to our food systems, IYAFA states its vision clearly: *a world in which small-scale artisanal fishers, fish farmers and fish workers are fully recognized and empowered to continue their contributions to human well-being, healthy food systems and poverty eradication through the responsible and sustainable use of fisheries and aquaculture resources.* As you read through this edition of *FAN*, take a moment to think about the "people behind the fish", and to reflect on what it means to be a small-scale fish farmer working during the global pandemic, ensuring that we have fish for our tables. The inside back cover has more information on IYAFA, and how you can be involved.

FAO never stopped working during the pandemic either, first shifting to work from home arrangements and adapting to the virtual environment, and then as the restrictions started to ease, increasingly in the office and in the field. One major event was the Global Conference on Aquaculture Millennium +20, a decadal aquaculture conference. The GCA +20 was a major success, and, indeed, the hybrid modality allowed even more people to participate than if it had been only presential. See the article on page 5 for a detailed

COVER PHOTOS:
Top photo: Small scale aquaculture farmers inspect mussel culture lines in Chile, under the project Strengthening the adaptive capacity to climate change in the fisheries and aquaculture sector of Chile ©FAO/Max Valencia.
Bottom photo left: Farmer in the United Arab Emirates shows a handful of Azolla, a sustainable feed ingredient for tilapia. ©FAO/FAME MEDIA.
Bottom photo right: A group of women feeding fish and testing water in Teknaf Upazila, Bangladesh. ©FAO/K. Coates.

description of major conference outputs, as well as a special section of this edition of *FAN* which invited poster authors, one from each thematic area of the GCA +20, to publish a short synopsis of their research. On another front, FAO has continued working with Members on the preparation of the Guidelines for Sustainable Aquaculture; and a global action plan for aquatic genetic resources is moving forward quickly in parallel with a global information system: both areas of work are discussed in their respective articles.

In the field, work has continued. Ranging from aquaculture field schools in Kenya to on-farm feeding guidelines in Eastern Europe and central Asia, from climate-adaptive practices in Chile to inland aquaculture in the Maghreb, FAO continues to provide its support. One particularly special article discusses gender in aquaculture, presenting different ways in which gender can be considered, and highlighting the gender transformative approach. Read this article in conjunction with the one on women's groups working with seaweed cultivation in Kenya to gain a multi-view perspective of FAO's work on gender in aquaculture.

The Fisheries and Aquaculture Division has settled into the new restructuring, aligning its activities along a strategy for Blue Transformation. Aquaculture takes its rightful place as a strong pillar of FAO's strategy to support and promote sustainable, inclusive and resilient blue food systems, tailored to country needs and regional contexts, promoted through upgraded policies and programmes for integrated science-based management, technological innovation and private-sector engagement.

Finally, I take this opportunity for a personal message to introduce myself. Elected by the *FAN* Editorial Board after the last edition, I am honoured to serve as the new Chief Editor of *FAN*, with special thanks to previous editors Lionel Dabbadie, Valerio Crespi and Melba Reantaso, who have provided unwavering support, guidance and advice and good humour as I have taken the reins over the last few editions. This position gives me a unique opportunity to engage with all FAO aquaculture colleagues across the world, a chance to look behind the curtain into their world as they share their work and their stories with me. I am grateful to all contributors of articles, and I hope that as Chief Editor I can share with you, the reader, their disparate and varied work, showcasing the activities of small-scale fish farmers and FAO's activities to support them.

Happy reading, and please stay safe!

Austin Stankus
Chief Editor
Aquaculture Officer
FAO Fisheries and Aquaculture Division, Rome, Italy
E-mail: Austin.Stankus@fao.org

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Aquaculture for Food and Sustainable Development
Global Conference on Aquaculture – Millennium +20

SUCCESS!

The Global Conference on Aquaculture Millennium +20 (GCA +20) was held 22–25 September 2021 in Shanghai, China, in a hybrid format.[1] Three keynote speeches followed by three guest lectures and nine thematic sessions presented by forty-seven expert panelists, the programme of the GCA +20 was an intensive two days of technical and policy discussions on aquaculture and led to the adoption of the Shanghai Declaration on Aquaculture for Food and Sustainable Development (the Shanghai Declaration). Over 100 academic posters and poster competition, a special topic workshop on *Artemia*, and a high-level segment rounded out the agenda. Of the more than 2 700 people who registered their interest via the GCA +20 website, a total of 1 728 participants from 114 Members attended the conference (500 in-person in Shanghai, 1 228 online), widely represented by a range of different stakeholders.

The ambitious objectives of the GCA +20 were met. First, we reviewed the status, trends and emerging issues in regional and global aquaculture developments and successfully presented the results of the seven well attended webinars held in October 2020, which addressed the Regional Aquaculture Reviews and the Global Synthesis; these are being published now.[2] There was much praise for these reviews, which provided the necessary quantitative information, facts and figures for the Shanghai Declaration. The preparation of these reviews is an essential part of FAO's work programme in aquaculture since 1995, conducted every five years, with the next round scheduled for 2025.

Written by:
GCA +20 Secretariat
E-mail: GCA@fao.org

Missed the GCA +20?
Want to watch again? Click on the links below for the video recordings

	PLENARY	STREAM 1 (orange)	STREAM 2 (green)	STREAM 3 (purple)
DAY 1	↘Link	↘Link	↘Link	↘Link
DAY 2	↘Link	↘Link	↘Link	↘Link

Second, the identification of opportunities and challenges in aquaculture and its contributions to sustainable development and an evaluation of the progress of aquaculture development were comprehensively covered in the nine thematic reviews that were prepared ahead of and discussed at the GCA +20, with the commenting period extended until after the GCA +20. The discussions on the most pressing issues and way forward were rich and insightful and provided a complementary source of indispensable qualitative information for preparing the Shanghai Declaration. There is some scope for improvement for evaluating the impact of previous declarations, and the outputs of the GCA +20 should serve as a baseline. It is recommended that indicators to assess further progress should be developed and integrated into Member reporting to the COFI Sub-Committee on Aquaculture through the CCRF Aquaculture Questionnaire. The thematic reviews will be published this year. Given the rapid advancement of the aquaculture sector, it is recommended to increase the frequency of analysis from every ten years to every five years.

1. https://aquaculture2020.org/programme
2. www.fao.org/fishery/regional-aquaculture-reviews/aquaculturereviews-home/en

Finally, the building of consensus on priorities and actions needed for advancing aquaculture as a global, sustainable and competitive food production sector was fully achieved, on the basis of the above sources of quantitative and qualitative information, with the unanimous adoption of the Shanghai Declaration by participants. As stressed during the deliberations, participants particularly welcomed the open, transparent and inclusive process that led to the adoption. The pledges and statements of support from over 40 eminent and influential organizations, institutions and networks are testament to the strong will of the global aquaculture community. In collaboration with partners at the community, sub-national, national, regional and international levels, now is the time for stakeholders to take the Shanghai Declaration to their constituencies and start implementing relevant provisions.

Shanghai Declaration: Aquaculture for Food and Sustainable Development

The key messages of the Aquaculture Regional Reviews, the Global Synthesis and the Thematic Reviews were used for the development of the key output of the GCA +20: the Shanghai Declaration on Aquaculture for Food and Sustainable Development (the Shanghai Declaration). The Shanghai Declaration was drafted by a small group of globally recognized aquaculture experts, followed by consultations with a wider group with appropriate technical, regional and gender balance expertise, which included members of the GCA's International Organizing Committee and the International Programme Committee. The draft was opened for comment by all registered participants, with comments incorporated to the extent possible. The Shanghai Declaration, which is a participants' declaration, was presented on the first day and unanimously adopted on the second day of the GCA +20.

The Shanghai Declaration highlights the principles and pathways to maximize sustainable aquaculture in achieving the Sustainable Development Goals (SDGs), and specifically presents:

- a shared vision of sustainable aquaculture
- five overarching commitments
- ten strategic priorities
- and a Call for Action

The Shanghai Declaration identifies global priorities and actions related to aquaculture's role in implementing and mainstreaming the SDGs and, over the next 10 years, to optimizing the contribution of aquaculture towards achieving the 2030 Agenda for Sustainable Development. The Shanghai Declaration is intended to act as a guide to stakeholders working towards sustainable aquaculture development under the Code of Conduct for Responsible Fisheries, but also the 2021 COFI Declaration[3] on its 25th Anniversary, the 2000 Bangkok Declaration[4] and Strategy as well as the 2010 Phuket Consensus;[5] and to underpin future national, regional and global integrated sustainable aquaculture development initiatives on capacity building, partnership and resource mobilization towards promoting food security, poverty eradication and rural development.

Her Royal Highness Princess Maha Chakri Sirindhorn, FAO Special Goodwill Ambassador for Asia and the Pacific and Guest of Honour, graced the conference by attending online and delivering the Royal Statement in which she pointed to the over forty years of her work on education and nutrition. She emphasized that aquaculture is a source of nutritious and inexpensive food, and how she has fully adopted aquaculture as a solution to achieve the goal of "Good Food for All" and her support of aquaculture as a "global solution" to reach SDG 2, which aims to achieve zero hunger.

During the Shanghai Declaration session on 24 September, over 40 organizations provided written statements of support, and about 20 organizations spoke to plenary afterwards. Pledges and statements of support are available on the GCA +20 website.

The Shanghai Declaration: Aquaculture for Food and Sustainable Development is available in the six United Nations languages here: www.aquaculture2020.org/declaration.

Aquaculture Regional Reviews and Global Synthesis

Since 1995, the FAO Fisheries and Aquaculture Department has produced Regional Aquaculture Reviews and a Global Synthesis every five years. These reviews provide up-to-date information on the status and trends of the sector at regional and global levels. The reviews pull from national, regional and global data sets and include expert opinions and literature reviews. The reviews can be of pertinent interest and use to national governments, regional organizations, policy-makers, aquaculture farmers and other aquaculture value chain actors, investors, civil society organizations, research and training institutions as well as interested stakeholders.

With the support of the Network of Aquaculture Centres in Asia-Pacific (NACA) and the World Fisheries Trust (WFT), as well as the technical contributions of leading aquaculture development experts and authors, FAO facilitated the preparation of six Regional Aquaculture Reviews and a Global Synthesis:

- Regional Review of Aquaculture in Asia and the Pacific
- Regional Review of Aquaculture in Europe
- Regional Review of Aquaculture in Latin America and the Caribbean
- Regional Review of Aquaculture in North Africa and the Near East
- Regional Review of Aquaculture in North America
- Regional Review of Aquaculture in sub-Saharan Africa
- Global Synthesis: World Aquaculture 2020 – A Brief Overview

3. FAO. 2021. 2021 COFI Declaration for Sustainable Fisheries and Aquaculture. Rome. https://doi.org/10.4060/cb3767en
4. www.fao.org/3/ad351e/ad351e.pdf
5. https://www.fao.org/fishery/docs/DOCUMENT/aquaculture/aq2010/Phuket_Consensus_13-12-2010.pdf

These reviews were first authored by selected aquaculture experts, extensively reviewed by colleagues of FAO, NACA and WFT, and peer reviewed by numerous invited experts worldwide. In addition, the draft Regional Aquaculture Reviews and the Global Synthesis, including their key messages, were presented and discussed during seven technical webinars held in October 2020 with the attendance of the authors, invited speakers, panelists, experts and more than 1 600 participants. The webinars provided opportunities for fruitful exchange and further improvements of the reviews. The Global Synthesis was presented as a keynote speech to the GCA +20, and participants were referred to the recordings of the October webinars for the regional reviews.

The six Regional Aquaculture Reviews and the Global Synthesis will be available on the dedicated FAO website.[6]

Thematic Reviews

Nine Thematic Reviews (see the list below) were developed to provide an additional evidence base for the GCA +20 and the Shanghai Declaration. For each theme, a group of technical experts was convened by FAO and commissioned to produce thematic review papers for corresponding sessions of the GCA +20. These themes, carefully selected by the International Programme Committee and chosen for their current and future relevance for the sector, covered technical topics on production, ranging from innovations in aquaculture systems to developments in feed and feeding practices, and from biosecurity to aquatic genetic resources and seed supply. Value chains, market access and consumer perceptions relate directly to social and human dimensions of aquaculture, including gender, nutrition and youth employment. Finally, aquaculture policies, planning and governance connect to the needed transformation of aquaculture towards achieving the SDGs. Each Thematic Review considered a number of cross-cutting issues, including biodiversity mainstreaming, climate change and capacity building, among others.

- Aquaculture systems
- Innovation and smart technology
- Feed and feeding
- Sustainable management and improvement of genetic resources
- Biosecurity and aquatic animal health management
- Transforming aquaculture to achieve the SDGs
- Policies, planning and sectoral governance
- Social and human dimensions
- Value chains and market access

The nine Thematic Reviews were presented by a core group of experts including the lead authors. Presentations were followed by a panel discussion with all participants invited to provide comments and questions. All draft Thematic Reviews were published online for a commenting period of six weeks, with all registered participants encouraged to provide input, comments or other feedback. The Draft Thematic Reviews are available online at www.aquaculture2020.org/thematic; the final Thematic Reviews will be published soon.

Conclusion and next steps

The GCA +20 reviewed status, trends and emerging issues in aquaculture development with a regional and global focus. The identification of opportunities and challenges in aquaculture and its contributions to sustainable development as well as an evaluation of the progress of aquaculture development were comprehensively covered in the nine thematic reviews. The discussions on the most pressing issues and way forward were rich and insightful and provided a complementary source of indispensable qualitative information. The building of consensus on priorities and actions needed for advancing aquaculture as a global, sustainable and competitive food production sector was achieved, with the unanimous adoption of the Shanghai Declaration by the participants. As stressed during the adoption, the participants particularly welcomed the open, transparent and inclusive process that led to the adoption. The pledges and statements of support of over 40 important and influential organizations, institutions and networks are testament to the strong will of the global aquaculture community.

The outputs of the GCA +20 will be presented at the 11th session of the COFI Sub-Committee on Aquaculture, to be held in Mérida, Mexico, 24–27 May 2022 (tbc), with a request to the Sub-Committee to take note of and consider further all the provided information, including the frequency of holding the Global Conference on Aquaculture, to advise the Secretariat on potential future work, to provide guidance on how FAO Members, regional and global partner organizations, and other stakeholders may best consider and address the recommendations of the Shanghai Declaration of the Conference attendees in their planning for future aquaculture initiatives, and to identify and support partnership and resource mobilization efforts to implement the recommendations of the Conference, including any relevant provisions of the Shanghai Declaration, in the promotion of sustainable aquaculture development initiatives.

6. www.fao.org/fishery/regional-aquaculture-reviews

Global Conference on Aquaculture Millennium +20
Poster Session

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Authors of selected posters from each of the nine thematic areas presenting their work to the plenary session of the Global Conference on Aquaculture Millennium +20. A recording of the poster presentations can be found **here**

Before the Global Conference on Aquaculture Millennium +20 (GCA +20), all registered participants were invited to submit academic posters. Youth, students, early career researchers and aquaculturists, farmers, producers and industry practitioners were particularly encouraged to participate. Operating under the guidance of the International Programme Committee, the GCA +20 Poster Committee, with representatives from FAO and Shanghai Ocean University, evaluated posters based on the clarity of the poster, its relevance to the thematic area, and its contribution to the overall GCA objectives and the overarching theme "Aquaculture for food and sustainable development".

All 100 posters, which were accepted from 25 countries, can be found online on the GCA website, organized by theme (www.aquaculture2020.org/posters). In addition, posters were printed and displayed in the conference venue in Shanghai, China, for the approximately 500 participants who attended in person.

Nine exceptional posters, one from each of the GCA themes, were selected by the GCA Secretariat. These nine authors presented their poster during a "lightening" session at the final plenary session and were then further invited to prepare a short article on their work for this edition of *FAN*. Their names, poster titles and direct links can be found in the table below, and their articles appear on the following pages.

The GCA Secretariat expresses sincere thanks to all poster authors. Not only was the quality and the diversity of these posters truly special, but they also underline the importance of youth engagement, as young women and men enter the aquaculture sector and become involved with new perspectives and fresh ideas.

One of the important messages from the GCA was the emphasis on the strong link that needs to exist between academia, policy and overall sustainable development. Strengthening the connections between universities, institutions and repositories of knowledge and decision-makers, policy-makers and farmers is essential to ensure that the sustainable development of aquaculture is guided by sound, science-based information and research.

Written by:

Austin Stankus

FAO Fisheries and Aquaculture Division, Rome, Italy

Junfang Zhang

College of Fishery and Life Science, Shanghai Ocean University, China

Theme	Author/presenter	Poster title and direct link
Aquaculture systems	Yiqin Deng	What drives changes in the virulence and antibiotic resistance of *Vibrio harveyi* in the South China Sea?
Innovation in aquaculture	Clémence Cordier	Culture of microalgae with ultrafiltered seawater: from a feasibility study to an industrial development
Transforming aquaculture to achieve the Sustainable Development Goals (SDGs)	Gabriel Esquivel-López	Proposals to boost sustainable development in aquaculture: the case of Mexico
Aquaculture feed and feeding	Samah Fettach	Effects of newly isolated microalgae on growth and survival of the Pacific oyster *Crassostrea gigas* spat
Aquatic genetic resources and seed supply	Grace Boamah	Sub-low salinity impact on survival, growth, and meat quality of the pacific abalone (Haliotis discus hannai) and hybrids
Biosecurity: reducing the burden of disease	Mary Nia M. Santos	Efficacy of tilapia oral vaccine coupled with a nanocomposite biomaterial as carrier for vaccine delivery
Dynamics of aquaculture governance	D.G. Nadeeshani Gamage	Seaweed Aquaculture in Sri Lanka: Challenges and Policy Recommendations for the Sustainable Development of the Industry
Social and human dimensions of aquaculture	André Luiz Medeiros de Souza	Aquaponics to improve quality of life of people affected by the disruption of the mining dam in Fundão - Brazil
Value chains and market access for aquaculture products	Patrick Nyakoojo	One stop center for fish products in value chain and market; bridging a technology gap in value chains and market access for aquaculture products.

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A poster author explains his research to a presential participant of the Global Conference on Aquaculture +20 in Shanghai, China

Disease Prevention and Control Based on Environmental Factors and Inputs is Essential to the Sustainable Development of Aquaculture

Added pressure to produce healthy fish can lead farmers to overuse antibiotics, leading to antimicrobial resistance among fish and raised pollution levels

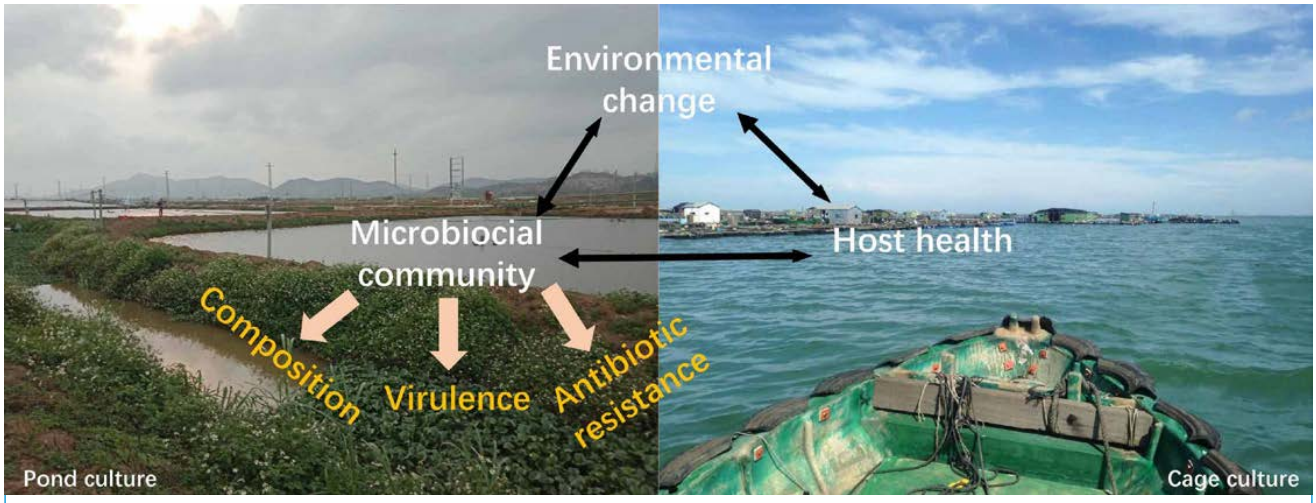
High-density farming, along with intense human activities and global climate change, can cause environmental deterioration, imbalances in the microecosystem and blooms of pathogens, problems that can affect aquaculture in different ways, such as frequent bacterial infection outbreaks, overuse of antibiotics and risks of antibiotic resistance. In order to achieve the goal of healthier and more nutritious aquaculture, the Ministry of Agriculture and Rural Affairs in China is implementing the "Green and Healthy Aquaculture" initiative. An important part of this initiative is encouraging early disease detection, monitoring of pathogen resistance, determining suitable local antimicrobial profiles, providing guidance for application and use of medication, and vigorously promoting vaccine immunization and ecological disease prevention and control (www.yyj.moa.gov.cn/gzdt/202104/t20210421_6366305.htm). Here, we systematically studied the aquatic microbial community, environmental changes, bacterial virulence and drug resistance of cage culture and pond culture of the South China Sea and analysed the relationships among them, trying to establish ecological prevention and control systems based on environmental factors and inputs to control the occurrence of diseases.

Written by:

Yiqin Deng

South China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences, Guangzhou, China

Infectious diseases are the result of complex interactions among hosts, the environment and surrounding microbial communities. Our research suggests that environmental variations, including water temperature, dissolved oxygen, phosphates and nitrates, resulted in the imbalance of pond water microbial community structure and function, which in turn affected survivorship of Chinese sea bass (*Lateolabrax maculatus*) (Deng *et al*., 2021). Several microbial taxa were identified that could be disease indicators: *Sporichthyaceae*, *Saprospiraceae*, *Chitinophagaceae*, *Microbacteriaceae*, and *Burkholderiaceae*; and one as a potential health indicator: Moraxellaceae. This result provides indirect evidence that suitable environmental conditions and associated microbial communities are crucial for maintaining aquatic animal health.



The interaction among environmental change, microbiocial community and host health

Antibiotics are widely used to prevent and treat bacterial diseases in aquaculture; however, excess use results in drug residues in water, which promotes the development of antibiotic resistance, the evolution of antibiotic resistance mechanisms and, consequently, the contamination of food and endangerment of human health. This investigation showed that antibiotic resistance and antibiotic resistance genes (ARGs) widely exist in both cage and pond culture areas in southern China, especially in relation to the resistance to sulfonamides and tetracyclines, and the corresponding ARGs. Additionally, significant antibiotic resistance was found in pathogens, including *Vibrio*, *Acinetobacter*, *Pseudoalteromonas* and *Alteromonas* (Wu *et al*., 2019a; Wu *et al*., 2019b; Wu *et al*., 2019c; Deng *et al*., 2020a; Deng *et al*., 2020b). Moreover, strong antibiotic resistance is likely to enhance bacterial virulence, making it difficult to treat infections. However, low detection rates were found for resistance to quinolones and chloramphenicols. These findings suggest that a strict supervision system for antibiotic use is needed for the sustainable development of aquaculture.

Environmental changes mediate microbial virulence and antibiotic resistance; the composition of the bacterial community structure is a key determinate of the abundance and activity of genes regulating virulence and antimicrobial resistance. Detection and analysis of virulence genes and ARGs of specific bacteria, such as *Vibrio*, and aquaculture water microbial communities showed that environmental changes, especially changes in water temperature, nutrients and oxygen, mediate microbial antibiotic resistance and/or virulence. This likely has effects on bacterial growth, enzymatic activity and horizontal gene transfer efficiency (Wu *et al*., 2019a; Wu *et al*., 2019b; Wu *et al*., 2019c; Deng *et al*., 2020a; Deng *et al*., 2020b, Deng, *et. al*., in press). Based on the above, the regulation of environmental factors, such as dissolved oxygen and nitrates, can be conducted to reduce drug resistance and bacterial infection risk in the aquaculture industry.

Environmental changes, such as nutrient load, global warming and antibiotic pollution, can destroy the microecological balance and therefore promote the virulence and drug resistance of pathogens. In the future, large-scale research is recommended to further study the response and response mechanisms of microbial composition, microbial virulence and drug resistance to environmental changes. Finally, specific environmental factors and taxa can be used as indicators of ARGs contamination and bacterial infection and can be used to establish an antibiotic elimination system and disease control system, consequently contributing to a more sustainable aquaculture industry.

Maintaining microecological balance and reducing pathogen infection and antibiotic resistance are major goals for aquaculture to be healthier and more nutritious. Ecological prevention and control strategies based on environmental factors and inputs are important to direct green, healthy and sustainable development of aquaculture in the future.

SEE ALSO

Deng, Y.D., Mao, C. & Chen, H.X., *et al.* 2021. Shifts in pond water bacterial communities are associated with the health status of sea bass (*Lateolabrax maculatus*). *Ecol Indic*, 127: 107775.

Deng, Y.D., Xu, L.W., Chen, H.X., *et al.* 2020a. Prevalence, virulence genes, and antimicrobial resistance of *Vibrio* species isolated from diseased marine fish in South China. *Sci Rep*, 10(1).

Deng, Y.D., Xu, L.W., Liu, X.L., *et al.* 2020b. What drives changes in the virulence and antibiotic resistance of *Vibrio harveyi* in the South China Sea? *J Fish Dis*, 43(8): 853–862.

Wu, J.J., Mao, C., Deng, Y.Q., *et al.* 2019a. Diversity and abundance of antibiotic resistance of bacteria during the seedling period in marine fish cage-culture areas of Hainan, China. *Mar Pollut Bull*, 141: 343–349.

Wu, J.J., Su, Y.L., Deng, Y.Q., *et al.* 2019b. Spatial and temporal variation of antibiotic resistance in marine fish cage-culture area of Guangdong, China. *Environ Pollut*, 246: 463–471.

Wu, J.J., Su, Y.L., Deng, Y.Q., *et al.* 2019c. Prevalence and distribution of antibiotic resistance in marine fish farming areas in Hainan, China. *Sci Total Environ*, 653: 605–611.

Culture of Microalgae with Ultrafiltered Seawater: From a Feasibility Study to an Industrial Development

Microalgae culture is intertwined with bivalve production and greatly dependent on water quality used for their production. To avoid the introduction of contamination (parasites that eat the microalgae such as copepods, or are harmful for bivalves, such as pathogenic bacteria and viruses) in microalgae culture and consequently within aquaculture production during feeding, the water used for phytoplankton growth must be treated. The objective of this research was to study ultrafiltration, a membrane process designed to remove particles that are greater than 0.02 µm, and to produce water for microalgae cultivation at semi-industrial and industrial scale. This work is part of a project that aims to study the potential of integration of membrane processes for water and effluents treatment within shellfish hatcheries and nurseries.

The study focused on two species of microalgae, *Tisochrysis* and *Tetraselmis*, commonly used for oyster feeding. They were cultivated in ultrafiltered water (prefiltration and ultrafiltration) and control seawater for comparison. The control seawater was treated in several steps: prefiltration, three filtrations and two ultraviolet disinfections. The cultures were carried out in real hatchery conditions, in semi-continuous mode (300-litre tanks) with the objectives to validate the use of ultrafiltered water for this application and evaluate if there were advantages of this process compared with classical treatments. During several months, daily measurements of physicochemical parameters of water, microalgae cultures and cell concentrations were realized and recorded, combined with microscopic observations.

The *Tisochrysis* cultures revealed higher microalgae concentrations in ultrafiltered (from 6 to 30 percent more than the reference culture in control seawater).

Written by:

Clémence Cordier

Philippe Moulin

Aix-Marseille University, Laboratoire de Mécanique, Modélisation et Procédés Propres, Aix en Provence cedex, France

Christophe Stavrakakis

Plateforme expérimentale Mollusques Marins, Station Ifremer de Bouin, Bouin, France

Adeline Lange

Frédéric Chenier

Vendée Naissain, Bouin, France

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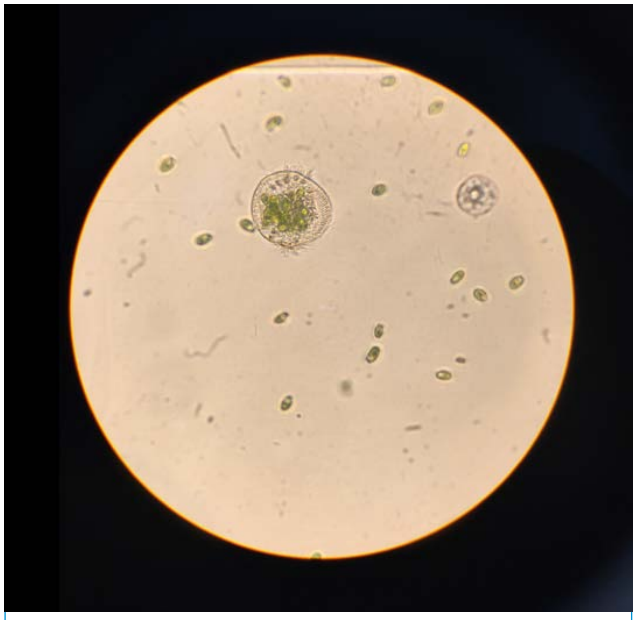
Cultures of *T-isochrysis* and *Tetraselmis* in ultrafiltered and control seawater

Tetraselmis cultures had similar concentrations in the two treatments, but ultrafiltration showed no grazers (unwanted microorganisms that eat algae). Indeed, copepods were observed in *Tetraselmis* cultures supplied with control seawater, although they were never detected with ultrafiltered water.

The experiment was then conducted at industrial scale with *Tisochrysis* cultivated in ultrafiltered seawater and control water (borehole water), at the company France Naissain / Vendée Naissain, a world leader in the production of oyster (*Crassostrea gigas*) spat. Algae cultures were grown in different volumes, from 250 mL to 30 L. The results confirmed the previous conclusion on the benefice of ultrafiltration: a greater mobility (microscopic observation of cultures) and less contamination were obtained with ultrafiltered seawater. Moreover, a shorter exponential phase of growth (25 percent) was observed, thus limiting glassware and daily transplanting time.

Ultrafiltration proved to be an efficient process to produce treated water for microalgae production, with benefits on protection, quality of the cultures and production efficiency. In terms of health and biosecurity, the protection efficiency of ultrafiltration leads to microalgae cultures without parasites and consequently to a bivalve production free from contamination and safe for consumers. This removal of contaminants was also validated with a study on significant oyster pathogens, ostreid herpesvirus-1 (OsHV-1) and *Vibrio* spp., particularly *Vibrio aestuarianus*. Ultrafiltration was able to remove those bacteria and viruses under detection limits in the case of *Vibrio* (20 colony forming units per mL) and to concentrations too low to



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Predators (ciliates) observed in a control *Tetraselmis* sp. culture in seawater

quality adapted to different production steps: oyster *Crassostrea gigas* fertilization, spat stage and effluent treatment/reuse.

There is now the potential of transferability to other aquaculture larval productions (such as other bivalves and finfish) fed both in marine and freshwater. Ultrafiltered water is free from pathogenic agents and parasites, and with constant quality is essential to guarantee food safety. Ultrafiltration proved its ability to be integrated in sustainable conditions into aquaculture by meeting water quality objectives at different key stages of production, including microalgae cultivation, to improve biosecurity. Application and use of ultrafiltration technology to other aquaculture applications for water treatment and production of water suitable for cultivated species are expected to contribute to sustainable development of aquaculture.

©FAO/C. Cordier

Magnified *Tetraselmis* sp., an important microalgae for aquaculture feed

impact oysters (larvae and spats) in production conditions in the case of OsHV-1. Regarding economic benefit, avoiding contaminations in microalgae cultures and in oyster breeding systems results in a reduction of medical treatments and production losses. The development of this process in aquaculture farms could be beneficial to the environment with the reduction of veterinary drug use. Furthermore, this process was shown to be efficient in removing bacteria and suspended solids from a real effluent from oyster breeding systems for reuse application and to eliminate oyster gametes to protect marine biodiversity against non-endemic species that could be produced or maintained within the hatchery or nursery.

Ultrafiltration is an innovative process that leads to safe and efficient aquaculture production by protecting microalgae, oysters and their consumers. The study focused on the integration of ultrafiltration within a shellfish hatchery/nursery, with successful upscaling; the process was validated for other applications, including pathogen removal and the production of water with a

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Proposals to Boost Sustainable Development in Aquaculture: the Case of Mexico

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Tilapia farmers in Veracruz, Mexico

Mexico is one of the five most biodiverse countries in the world, but it also ranks first in Latin America in terms of threatened species. Aquaculture contributes to environmental threats, as it can pose conservation risks to native species from habitat and ecosystem disruption and other environmental impacts. Irresponsible wastewater disposal is also an unsustainable practice. Fish farming in Mexico has evolved over time, becoming stronger by the end of the twentieth century. During the early development of aquaculture, environmental impacts were often overlooked, creating challenges for the sustainability of the sector with reference to the FAO Code of Conduct for Responsible Fisheries and relevant Mexican environmental policies.

Written by:
Gabriel Esquivel-López
The College of Veracruz, Mexico
Laura Celina Ruelas-Monjardín
Higher Technological Institute of Xalapa, Mexico

The objective of this study was to evaluate the contribution of aquaculture to Sustainable Development Goals 2 and 12 in terms of the national environmental policy that has governed aquaculture from its origins to the present. A historical review of this activity was made regarding the various production models and the paradigms of environmental management of the rural economy, environmental protection, resource management and sustainable development.

The study was broken down into three components:

1. Historical development of aquaculture between the sixteenth and twenty-first centuries, including its promotion and guidance, the evolution of aquaculture production methods and the different species produced.
2. The impact of the environmental regulatory mechanisms on aquaculture in Mexico, including institutions, legislation, and environmental and water regulations.
3. The adoption of environmental policies by the actors in the sector, considering the behaviour of the different actors involved as reported in

academic literature and online in newspapers, from environmental and aquaculture institutions, producers, researchers, technicians and legislators, under the umbrella of the economic, social, environmental and political sustainable dimensions.

The study identified seven aquaculture environmental management relationship issues within the scope of the rural economy paradigm: (1) non-compliance with environmental permits; (2) fines, penalties and closures; (3) pollution conflicts; (4) complaints from society; (5) lack of federal zone concessions; (6) lack of updated records; and (7) ineffectual administrative responsibility. Recommendations to Mexican decision-makers were made, with 46 proposals put forward. One of them was the promotion of conservation aquaculture, a milestone on the road to sustainability. Other interinstitutional improvements to promote sustainable aquaculture programmes were recommended, including the use of native and endemic species, rational use of water, implementation of effective management structures, and promotion of good practices and controlled systems. Environmental and water regulations were further elaborated upon, including the application of Integrated Water Resources Management, priority given for non-excessive water use, differentiated policies in the regulation and payment of rights, and increased affordability for sustainable aquaculture and production for self-consumption.

Seven challenges were considered necessary to achieve sustainable development: paradigm shift from frontier economics to sustainable development; compliance with environmental obligations; minimization of environmental impacts; social participation; institutional responsibility; strengthening of the public sector; and legislative improvements. Likewise, it stands out as an indirect achievement that some demands made on water policy have been reflected in the new initiative of the General Water Law, of 18 August 2021, which intends to replace the National Water Law that has been in force for 29 years, highlighting the relevance of making differentiated policies between the small producer that predominates in Mexico and those with larger production.

The results show that despite the environmental context faced by aquaculture in Mexico, there is a critical situation of noncompliance with the environmental policy. The aquaculture law has been insufficient, and solutions are not prioritized. This historical analysis, based on the sustainable approach, can be extended to verify the context at the macro level (countries) and the promotion of conservation aquaculture and protection of endangered species and ecosystems.

Achieving the goals of the 2030 Agenda for Sustainable Development requires the implementation of local policies and dedicated efforts to update the laws with the most progressive, sophisticated, and sustainable techniques that represent modern aquaculture in order to prioritize responsible aquaculture and its regulation.

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Striped bass farming on Todo Santos Island, California, Mexico

Effects of Newly Isolated Microalgae on Growth and Survival of the Pacific Oyster (*Crassostrea gigas*) Spats

Experimental design of microalgae culture in different seawater treatments

Aquaculture production plays an important role in meeting the global demand for aquatic products, of which bivalves make up a large proportion. In Morocco, the Pacific oyster is the largest cultured species, currently constituting 72 percent of marine aquaculture production. Also, Morocco has significant assets favourable to the development of shellfish aquaculture, and many zones are allocated for this activity. Therefore, it is essential to improve the independence of shellfish farms through the local production of spats necessary for the development of this sector. In this case, the culture of appropriate microalgae is significant to marine aquaculture, especially bivalve hatcheries, as microalgae are the only suitable food source.

Written by:
Samah Fettach
Mohammed Elyakoubi
Mohamed Idhalla
The National Institute of Fisheries Research, Morocco

In this study, five local species of microalgae (*Chaetoceros* sp., *Thalassiosira* sp.1, *Tetraselmis* sp.1, *Tetraselmis* sp.2 and *Nannochloropsis* sp.) were isolated from four sites along the Moroccan coast. The selection of these species was based on the morphological and physiological patterns of cells and also their nutritional value, which depends on the presence of certain fatty acids deemed to be essential. The feeding experiments were carried out on diploid *Crassostrea gigas* spat placed in 12 litre polypropylene plastic tanks inside which a cylinder sieve was placed to keep the spat suspended in the water. The seawater used was treated by filtration through a sand filter (20 µm) and sterilized with UV light and was renewed every two days. The growing conditions were maintained in optimal ranges: temperature (18–20 °C), salinity (34–36 grams per litre), pH (8–8.3), and adequate aeration was provided by a bubbler. A total of 31 diets consisting of all possible combinations (in equal proportions) of the isolated microalgae were tested. Five diets were single-species diets and the others were mixed diets. The oysters were fed once a day every weekday at a rate of 4 percent of their body weight (as per Helm *et al.*, 2006). The

feeding trial lasted eight weeks, and survival rate and spat growth were monitored weekly. The difference in growth between the different batches of oysters at the end of the experiment was tested by one-way ANOVA ($p < 0.05$). The normality of the data was previously checked by the Shapiro-Wilk test and the homogeneity of variances by the Bartlett test. The Kruskal-Wallis test ($p < 0.05$) was used when the ANOVA assumptions were not met. These statistical analyses were performed using R Studio version 1.2.1335.

The results demonstrated significant differences in growth rates among the diets tested ($p < 0.05$). In general, multispecies diets performed better than the monospecific diets, and higher shell growths were obtained with multispecies diets, especially the diet D8 composed with two species *Chaetoceros* sp. and *Tetraselmis* sp.2. Indeed, the average size increased from 5.9 to 11.83 mm, equivalent to 0.74 mm per week, and a survival rate of 66 percent. In a study of the effect of mixed microalgal diets on growth of European oyster *Ostrea edulis* juveniles, the best growth rate of spats was 0.85 mm per week obtained with the two species *Nannochloropsis oculata* and *Pavlova lutheri* in a mixed diet but at a higher rate of 10 percent (Ronquillo *et al*., 2012). Our results also demonstrated that the presence of *Nannochloropsis* sp. in the diets lead to the lowest survival rates.

In conclusion, the optimization of the growth and survival of spats in hatcheries is a critical point at which to decrease production costs and achieve the sustainable development goals of shellfish aquaculture. However, further studies on physiological pattern (absorption rate and efficiency) could better explain the feeding behaviour of oyster spats.

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Culture of microalgae used to feed spats

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Crassostrea gigas spats used for the experiment

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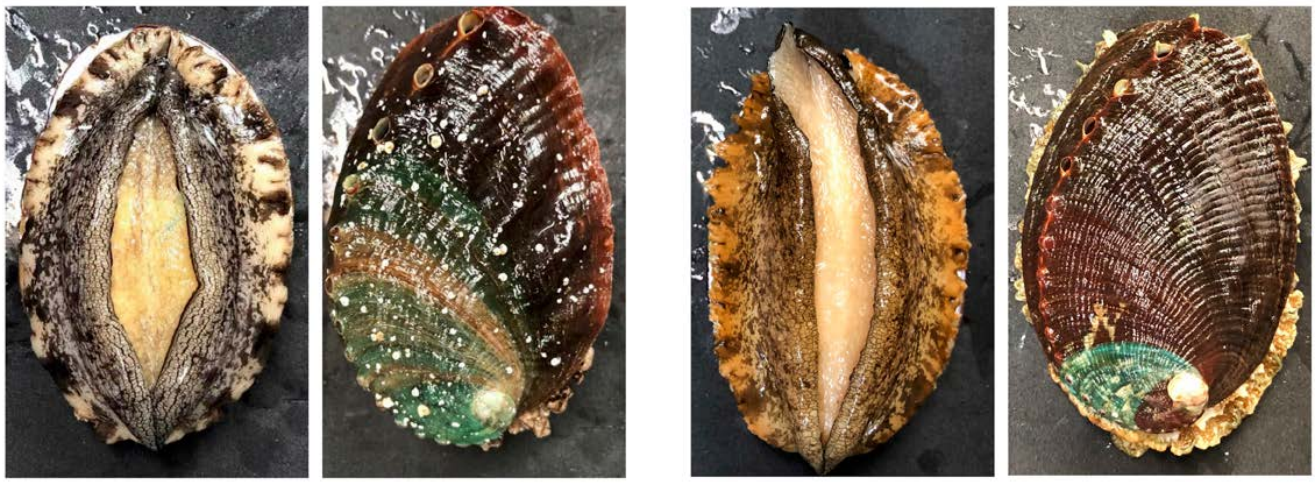
Low Salinity Impact on Survival, Growth and Meat Quality of the Pacific Abalone (*Haliotis discus hannai*) and Hybrids



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Haliotis discus hannai (DD)

H. discus hannai ♀ × *H. fulgens* ♂ (DF)

H. gigantea ♀ × *H. discus hannai* ♂ (SD)

The Pacific abalone *Haliotis discus hannai* and two of its hybrids (DF and SD)

After almost 30 years of commercial farming, China has emerged as the leading global producer and consumer of abalone. In recent years, suboptimal environmental conditions have reportedly impacted aquaculture organisms negatively. Salinity is one of these important environmental factors, and its fluctuation affects survival, growth, and potentially, the meat quality of the organisms with narrow salt tolerance, especially when cultured in coastal areas and inner bays. However, the farming of hybrids has gained popularity on most abalone farms in China due to their superior resistance to environmental stresses.

Written by:
Grace Afumwaa Boamah
Caihuan Ke
Weiwei You
College of Ocean and Earth Sciences, Xiamen University, Xiamen, China

The main objectives of this study were to ascertain if:

1. The meat quality of abalone cultured in low salinity zones of coastal and inner bays would be negatively impacted compared with abalone grown in full salinity seawater.
2. Hybrids noted for high survival and fast growth over their paternal/maternal parents would also maintain their nutritional quality during salinity changes.

Consequently, 360 abalone comprising of three farmed types were tested at four salinity treatment levels –34, 32 (as

control), 30 and 28 parts per thousand (ppt) – for 90 days.

The three farmed types were:
– Pure species *Haliotis discus hannai* (DD)
– Hybrid *H. discus hannai* ♀ × *H. fulgens* ♂ (DF)
– Hybrid *H. gigantea* ♀ × *H. discus hannai* ♂ (SD)

The study recorded survival rate, condition index, moisture content and some growth parameters, such as total meat yield and weight gain. In addition, meat quality parameters, including crude protein, ash, lipids, macro and micro minerals, and total carbohydrates were analysed using the proximate analysis methods. The data show that weight gain, specific growth rate in wet weight, and total meat yield were significantly higher in the hybrid DF than in the SD hybrid and the pure species DD. Also, SD demonstrated a significantly high content of most essential minerals compared with DF and DD. Furthermore, the low salinities tested did not influence moisture content, crude protein, total lipids and total carbohydrates in any of the farmed types. This suggests that it is possible to culture abalone at the low salinity of 28 ppt.

The key findings are that the hybrids offer a faster growth rate, higher survivorship and a relatively high content of essential minerals. Also, abalone can retain their nutritional composition, and hence remain nutritious, at the low salinities tested. Hybridization is a breeding technology that could increase seafood availability in both quantity (due to the high survival and faster growth of some hybrids) and quality (because of the high levels of protein, good fatty acids and essential minerals that are maintained even under suboptimal environmental conditions). As aquaculture stakeholders across the globe seek to promote sustainable aquaculture through technology and production, hybridization could be a potential method for breeding more stress-resilient farmed types.

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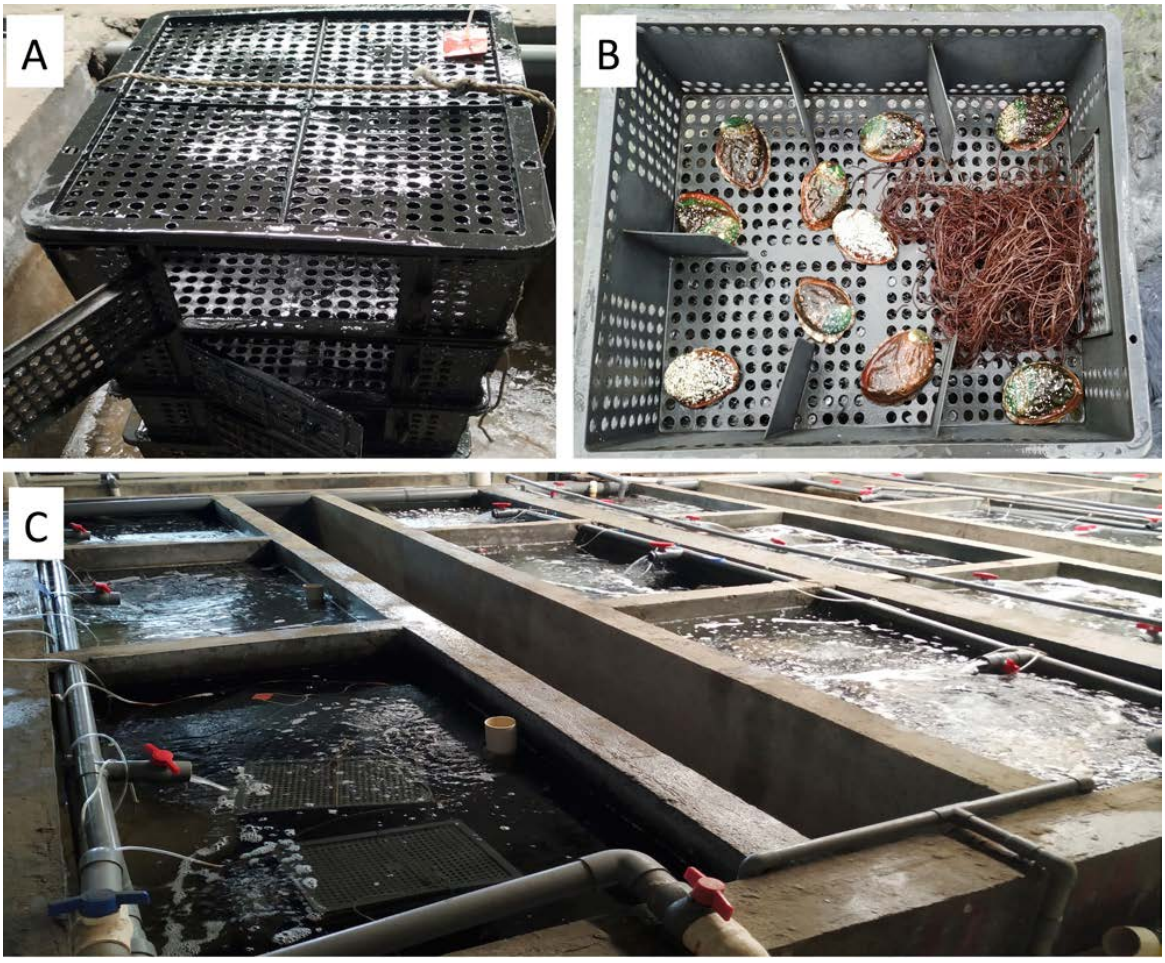

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Experiment setup: A) Cages for sheltering abalone, B) Opened cage showing abalone and red algae for food, and C) Concrete tanks with submerged abalone cages

Efficacy of Tilapia Oral Vaccine Coupled with a Nanocomposite Biomaterial as Carrier for Vaccine Delivery

Fish diseases have seriously threatened and hampered the aquaculture industry. Low stress yet effective mass vaccination strategies for disease control and prevention are needed for sustainable aquaculture. Fishvax, a vaccine using a nanocomposite biomaterial for oral delivery, was developed and applied in this study for vaccination against *Aeromonas veronii*, a bacteria that can cause major disease outbreaks in fish.

The project team, based at the Institute of Biology, College of Science, University of the Philippines Diliman, was headed by Dr Anacleto Argayosa, in collaboration with Dr Rolando Pakingking Jr of SEAFDEC Aquaculture Department. The project was funded by the Department of Science and Technology, Philippine Council for Aquatic and Marine Research and Development, now the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development.

The vaccine is coated on the fish pellet and fed to the fingerlings during mass immunization. The encapsulation technique protects the bacterial antigens from destruction in the stomach and releases the microencapsulated, killed pathogen in the fish gut where immune cells process it from the systemic and gut-associated immune response. Antibody levels were analysed using enzyme-linked immunosorbent assay, and quantitative PCR of immunoglobulin M (IgM) mRNA in the spleen and other tissues such as the liver, head kidney and muscles were performed. Close to a 10-fold increase in IgM levels was observed in vaccinated fish, enough to give a relative percent survival of 67 percent in tank trials and 53 percent in grow-out field trials in fish cages versus the challenged and non-vaccinated fish, respectively.

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Sample of fish feed pellets with the nanocomposite biomaterial

In summary, oral vaccination of tilapia with inactivated *A. veronii* using phyllosilicate as the vaccine carrier potently induced humoral adaptive immune response and conferred significant protection against *A. veronii* infection. The potential of oral vaccine using phyllosilicate carrier against other motile Aeromonas septicemia causing *Aeromonas* spp. warrants further investigation.

This advancement in vaccine delivery system may improve tilapia production and reduce huge economic losses. Importantly, the platform technology can be developed for oral vaccine against other important fish pathogens including viruses. This initial work is continuing with the research on "Use of Fish Oral Vaccine in Tilapia Aquaculture System" funded by DOST – Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development in collaboration with an industry partner, Santeh Feeds Corporation.

Written by:

Mary Nia M. Santos

Aquatic Animal Health Section, Aquaculture Research and Development Division, Department of Agriculture, National Fisheries Research Development Institute Quezon City, Philippines

Rodolph Charles N. Rosel

Institute of Biology, College of Science, University of the Philippines, Diliman Quezon City, Philippines

Rolando V. Pakingking Jr

Aquaculture Department, Southeast Asian Fisheries Development Center, National Highway, Tigbauan, Iloilo, Philippines

Anacleto M. Argayosa

Biology Department, College of Arts, Sciences and Education, Trinity University of Asia Quezon City, Philippines (Corresponding author)

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Seaweed Aquaculture in Sri Lanka: Challenges and Policy Recommendations for the Sustainable Development of the Industry

Sri Lanka is an island situated to the southeast of the Indian subcontinent between the Arabian Sea and the Bay of Bengal. Nearly 400 seaweed species can be found in Sri Lanka along its extensive coastline, estimated as 1 585 km. Despite Sri Lanka's diversified seaweed repository, the exotic carrageenophyte *Kappaphycus alvarezii* is the only seaweed species commercially cultivated in the northern and northwestern coasts of the country. Seaweed farming is a fairly new practice in Sri Lanka and has shown strong growth in recent years.

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Well growing *Kappaphycus alvarezii* in Northern coast of Sri Lanka

This study provides an overview of environmental and socio-economic challenges faced by Sri Lankan seaweed farmers and suggests policy recommendations for sustainable development of the industry. Information was collected through an electronic search (ScienceDirect, Web of Science, Google Scholar and Scopus), a library search for articles published in peer-reviewed journals, and a literature search through books on seaweed aquaculture. Additionally, national and trade annual reports on fisheries and aquaculture performances were collected through the websites of the National Aquaculture Development Authority and the National Aquatic Resources Research and Development Agency to identify the growth of the seaweed industry in the past ten years in Sri Lanka. These two national institutions are responsible for the aquaculture research and development of the country, functioning under the Ministry of Fisheries and Aquatic Resources Development (MFARD). Moreover, the website of MFARD was used to identify the relevant national laws and regulations for seaweed aquaculture.

Written by:

D.G.N.D. Gamage

Faculty of Science and Technology, University of Nantes, France

N. Senthuran

Salford Business School, The University of Salford, United Kingdom

H.M.G.K. Herath

Faculty of Science and Technology, University of Nantes, France

Findings revealed that adverse weather conditions, absence of proper sites for seaweed farming, inferior quality of parental plant materials (genetic resources), marketing issues and a lack of standards for post-harvest practices and value-added products were the key environmental and socio-economic challenges faced by Sri Lankan seaweed farmers. Longer periods of high temperatures, heavy rainfalls and stronger waves, which are associated with seasonal monsoonal weather patterns, also limited the cultivation cycles of seaweed per year. These unfavourable changes in environmental conditions have led to variations in the harvesting time, thereby leading to harvesting immature seaweeds, retarding the growth and quality of seaweeds.

Under the present circumstances, seaweed-farming locations are co-managed by coastal villagers, and a considerable proportion of the existing farms are considered to be "idling" seaweed farms. The areas that have been abandoned for a long time have created a dirty and more disorganized system within the permitted areas for seaweed farming. Some legal restrictions imposed by the government for coastal conservation and management also undermine the growth of seaweed aquaculture. In general, farmers practice clonal propagation of seaweed using older stock or the previous harvest. Long-term usage of older seaweed stocks is likely to result in inferior plants

from prolonged use over a period of time. Hence, farmers are unable to get an optimum harvest due to the declining quality of the existing seaweed genetic material. Moreover, farmers encounter difficulties in drying seaweeds during rainy seasons.

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Carrying seedlings attached to monolines to the culture site

The Sri Lankan seaweed industry entirely depends on overseas processors. By providing technical and advisory support, buyers purchase seaweeds from growers at lower prices. In addition, the lack of standard prices for seaweeds among local traders, few buyers and unavailability of other marketing channels have discouraged many seaweed farmers. On the other hand, quality standards for dried seaweed are not customary within the system of Sri Lanka, and at present buyers pay a uniform price for dried seaweed regardless of quality. Although value addition of seaweeds is a good venture for women and families in coastal communities, lack of technological and financial support are major barriers. Pest and disease outbreaks are not recorded as prominent barriers, but non-infectious diseases such as "ice-ice" disease and fish grazing incidents have also been reported in the past.

As a result of this study, several major policy initiatives are recommended: (i) strengthening research programmes to identify new indigenous farmed types (e.g. new species or varieties) or developing commercial farmed types to improve the yield, disease and stress resistance; (ii) establishing national seed banks to maintain high quality and healthy seed stock; (iii) promoting investments for seaweed ventures by public-private partnerships; (iv) diversifying seaweed aquaculture systems; (v) developing post-harvest technology aspects of seaweeds in terms of drying and storage; (vi) developing the capacity building of farmers to improve biosecurity; and (vii) introducing low-interest loan and insurance schemes as financial assistance. Furthermore, preparing a zonal plan for seaweed aquaculture along the coastline and declaration of designated areas for seaweed aquaculture through a government gazette are crucial.

Seaweed aquaculture can provide an alternative economic opportunity for livelihoods of coastal communities by generating employment opportunities, especially for women in Sri Lanka. Therefore, addressing the aforementioned priorities may underpin the production and productivity of seaweed aquaculture while balancing the economic growth and ocean health. In conclusion, the declaration of precise regulations and guidance on seaweed aquaculture is paramount for ensuring environmentally and socially responsible seaweed aquaculture in Sri Lanka.

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Seaweed drying on the ground using nets in Northern province, Sri Lanka

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Aquaponics to Improve Quality of Life of People Affected by the Disruption of the Mining Dam in Fundão, Brazil

On 5 November 2015, the Fundão dam, owned by the Samarco mining company (Resplendor, Brazil), collapsed, spilling 43.7 million m³ of mud and mining waste and causing the death of 19 people, flooding homes and leaving a trail of destruction that affected the soil, rivers and springs. Considered the most significant environmental disaster in the country, just in the first month after the event 11 tonnes of dead fish were removed from the Doce River. The spill affected the river, in both the states of Minas Gerais and Espírito Santo, the riverside communities, and the flora and fauna of the area.

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Aquaponic project team meeting with members of e Krenak tribe, near Resplendor, Brazil

This project aimed to improve the quality of life of riverside communities affected by the rupture of the mining tailings dam of Fundão in Resplendor, Brazil, by implementing aquaponic systems. The objective was to improve food security through alternative ways of producing vegetables for non-food purposes. Occurring in 2015, the event devastated the populations in the area, especially the indigenous culture of the Krenak ethnic group. The project, based at the UFMG School of Veterinary Medicine, offered the opportunity to establish a small-scale aquaponics system for riverside families to improve their quality of life affected by the collapse of the Fundão dam, which polluted the Doce River, the primary source of food and income for families.

Aquaponics can be an alternative for the production of healthy and safe food. Meetings with communities and dialogic means were used to develop an action plan to implement and monitor the project's development. The first system was built in Resplendor within the Krenak indigenous community. The community received specific training on the management necessary to maintain the aquaponic system. A 310 litre tank for cultivating fish was installed, and three beds (60 cm × 90 cm × 30 cm) of expanded clay were built on logs of cut wood, where the vegetables were placed. The fish species chosen were tilapia (*Oreochromis niloticus*) and lambari (*Astyanax bimaculatus*), the latter species native to the Doce River. The fish were fed daily with commercial feed containing 28 percent raw protein. The Krenak community used the aquaponics system not only to raise fish but also to produce herbs such as basil, mint and rosemary, which they use for food and in rituals. Besides two face-to-face visits to the community, the team maintained weekly telephone contact for technical support. A fundamental point in working with traditional people is respect for the ethnic traditional culture. The maintenance of this system also contributed to reducing the severity of cases of depression among indigenous people.

The key findings were the recovery of the tribe's socio-cultural activities and the possibility to consume safe food and herbs, previously obtained easily and frequently. In

Written by:

Lílian Viana Teixeira

Universidade Federal de Minas Gerais – UFMG/Belo Horizonte, Brazil

André Luiz Medeiros de Souza

Fundação Instituto de Pesca do Estado do Rio de Janeiro – FIPERJ/Rio de Janeiro, Brazil; Universidade Iguaçu – UNIG/ Rio de Janeiro, Brazil

Fernanda Emi Amemiya; Camila da Mota Freitas; Daniele Salgueiro de Melo; Debora Cristina Sampaio de Assis; Matheus Anchieta Ramirez

Universidade Federal de Minas Gerais – UFMG/Belo Horizonte, Brazil

Andre Muniz Afonso

Universidade Federal do Paraná – UFPR/Palotina, Brazil;

Andrea Lafisca

Faculdade de Medicina de Juazeiro – Universidade Estácio/Bahia, Brazil

addition, the daily care of the system had an outstanding contribution to the improvement of cases of depression. It is believed that the most suitable arrangement in similar situations is the construction of small-scale aquaponic modules for each family nucleus, providing the maintenance and daily interaction of all members with the system. This type of social investment is highly viable.

Aquaponics was a good alternative to improve the quality of life of communities, as in the case of a population at risk, functioning organically with the environment. Aquaponics proved to be an efficient and inexpensive way to produce safe food, and was fast to build, easy to maintain and sustainable.

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Aquaponic system soon after installation

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Aquaponic system after several months showing vigorous plant growth

FAO Members Drive Forward the Agenda on Aquatic Diversity Management

Report on the Third Session of the Intergovernmental Technical Working Group on Aquatic Genetic Resources for Food and Agriculture

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Opening of the Third Session of the Intergovernmental Working Group on Aquatic Genetic Resources and Technologies

The Third Session of the Intergovernmental Technical Working Group on Aquatic Genetic Resources for Food and Agriculture (Working Group)[1] took place from 1 to 3 June 2021. This Working Group is one of the subsidiary bodies of the FAO Commission on Genetic Resources for Food and Agriculture (Commission).[2] Initially formed as an ad hoc body to guide FAO in the preparation of the first-ever global assessment on *The State of the World's Aquatic Genetic Resources for Food and Agriculture* (the Report), published in 2019, the Working Group was established by the Commission's Seventeenth Session in 2019 as a regular subsidiary body. Its mandate is to advise the Commission on issues specific to the aquatic genetic resources (AqGR) used for food and agriculture and review FAO efforts in implementing the Commission's programme of work related to AqGR.[3]

This Third Session was conducted virtually and attended by 72 countries and more than 200 delegates. It represented an important moment because it was the first occasion for FAO to present the findings of the Report to the Working Group but also because it called on the Working Group to discuss and provide guidance on two major global initiatives on which FAO is currently working in response to the findings of the Report:

– the preparation of a *Global Plan of Action for the Conservation, Sustainable Use and Development of Aquatic Genetic Resources for Food and Agriculture* (Global Plan of Action); and
– the development of a global information system for farmed types[4] of AqGR.

Additional items on the meeting agenda were a series of cross-sectoral issues within the Commission multi-year plan of work, including access and benefit-sharing; digital sequence information; the role of genetic resources in mitigation of and adaptation to climate change; applications

Written by:
Daniela Lucente
Graham Mair
FAO Fisheries and Aquaculture Division, Rome, Italy

1. www.fao.org/aquatic-genetic-resources/activities/itwg/third-session-documents/en.
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of biotechnologies in management of genetic resources; and the possible reorganization of the Commission's future intersessional work.

The session generated a number of important outcomes. The Working Group revised the draft Global Plan of Action (GPA), to be presented to the Eighteenth Regular Session of the Commission (27 September– 1 October 2021), and very positively welcomed and supported FAO's efforts in building the global information system. Details of the prototype information system are provided in an article in this issue of *FAN* (page 47). The GPA for AqGR and the global information system are closely interlinked activities. This was recognized by the Working Group in that it recommended, *inter alia*, that the Commission request FAO to develop a system for monitoring the implementation of the GPA and that a series of indicators be developed and incorporated into the global information system that FAO is developing. In recognition of the role that a global information system can play in facilitating informed decision-making and providing critical information to AqGR stakeholders, the Working Group recommended that the Commission request FAO to continue with the transformation of the prototype into a fully functional global information system. It also requested FAO to consider the possible integration of the system with other existing information systems and data sources and to conduct a communication and awareness-raising campaign targeting relevant actors, including breeders, farmers and researchers, on the existence, intended use and potential applications of the global information system.

On cross-sectoral issues, the Working Group made key recommendations, which included the development of a common approach, for all sectors of genetic resources, on how climate change will be addressed in future assessments and policy instruments. The Working Group also proposed that FAO regularly disseminate, through the Commission's existing databases, networks and newsletters, updated information on biotechnologies for the conservation and sustainable use of genetic resources and information on capacity requirements for their application.

The Working Group thanked the outgoing Secretary, Matthias Halwart, for his service and welcomed the incoming Secretary, Graham Mair, and wished him success during his tenure. The Members also elected a new bureau with Alexis Peña (Panama) as Chair, Colin McGowan (Canada) as Rapporteur and representatives from Morocco, Norway, the Philippines and Saudi Arabia. The Working Group also thanked the outgoing Chair, Ingrid Olesen (Norway), and the outgoing members of the bureau for their service.

This Third Session of the Working Group was particularly successful, not only because it met all its objectives through a constructive dialogue between participating countries but also because of its high attendance, which was significantly greater than in previous sessions, with some countries represented by multiple delegates. This likely reflects the relative ease of attending the session in a virtual format, especially for developing countries, but may also reflect the growing interest in, and recognition of, the importance of aquatic biodiversity.

FAO is grateful to the Working Group for the guidance provided on its future work on AqGR, and it is strongly committed to continue meeting its expectations.

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Pike-perch juvenile (*Sander lucioperca*) occurring in a canal of Lake Kolon, Hungary

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Aquaculture Field Schools in Kenya to Strengthen the Aquaculture Business Development Programme

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Aquaculture Field School exchange visit

The Government of Kenya, through the aquaculture component of the Economic Stimulus Programme (2011–2013), was able to obtain a loan of USD 67.9 million from the International Fund for Agricultural Development (IFAD) with additional funding from the Government and beneficiaries comprising a total of USD 143.3 million to launch the Aquaculture Business Development Programme (ABDP). The Government requested FAO technical assistance to train extension officers with a Farmer Field Schools (FFS) approach. FAO launched a USD 250 000 Technical Cooperation Programme (TCP) entitled "Aquaculture Business Development Project (TCP/KEN/3703)" developing Aquaculture Field Schools (AFS). As the FFS formula has been well developed in Kenya, it was simply a matter of sharing important fish culture terminology with the consultant in charge of training the AFS facilitators. A fisheries officer and a master trainer assisted in training 46 (37 men and 9 women) AFS facilitators for a period of 21 days, following a strict FFS curriculum and methodology. Upon graduation, the facilitators were deployed to seven counties in Kenya, coinciding with the selected counties by the ABDP.

Each facilitator formed a group of 25 to 30 persons to teach leadership capabilities to women and youth for decision-making. The beneficiary communities selected the members of the group to participate in the AFS. These groups have been extremely useful in contributing to

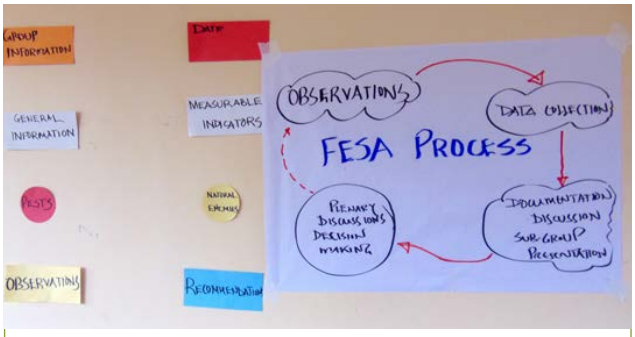
Written by:
Martin Van der Knaap
Subregional Office for Eastern Africa, Addis Ababa, Ethiopia
Alice Jesse
FAO Representation to Kenya

gender equality, women and youth empowerment and in assisting rural populations to participate in development initiatives (tree nurseries, fish processing and fish-recipe development).

Group trainings started in a selected location, focusing on resources management such as a common water supply source. The facilitators encouraged fish farmers to act collectively rather than individually so that everyone could benefit from the new farming practices and technology. The expected result of the project intervention was to transform the groups into cooperatives or associations with legal status and with a national outlook on fish farming. It appeared, however, that the duration of the project was insufficient to achieve that goal. In addition, the impact of the COVID-19 pandemic was clearly felt during the implementation of the project. The final results of the trainings included improved tilapia and catfish production, reduced impact on the environment, participation in value chains, access to financial services, and women and youth empowerment.

The Aquaculture Field School's objective is to give a voice to rural women, youth and the vulnerable and contribute to social and economic empowerment by increasing their skills in fish farming, entrepreneurship, and access to aquaculture services and resources such as farm inputs, credit facilities and aquaculture business management. In addition to fish farming activities, groups discussed family health, nutrition, financial management and business acumen for which speakers were invited to address concerns of the group. These special topics were suggestions from the groups to fill information gaps identified by the groups during their meetings. The groups expressed interest in new technologies, including aquaponics, black soldier fly culture and Moringa seeds as fish feed ingredient. The project not only concentrated on fish farmers but also on fish breeders. A number of adaptable technologies include hatchery operations, hormone injection, pond management, seed rearing, feeding, brood fish management and other steps of polyculture operations.

Processing on-farm fish feed in an Aquaculture Field School



Learning steps of an Agriculture Field School

How does AFS work?

The AFS groups are composed of women and men fish farmers as well as vulnerable members of the community. They meet regularly (mostly once a month) to discuss aquaculture-related issues in relation to their enterprises along the aquaculture sector value chain.

In one of the counties (Kakamega), communities that did not participate in the initial AFS requested the establishment of additional groups. Two previously-trained facilitators formed nine new groups. At the end of the project, a total of 80 groups had been established, many more than the original target.

Evidence of positive changes

The training provided has produced evident changes in behaviour, particularly in practice and perception of men and women in the rural communities regarding fish culture. The project had a positive effect on all these 80 AFS groups who sold some of their harvest and purchased fingerlings and fish feed for the next production cycles. Other positive project contributions were the strengthened extensionists interacting with the AFS groups, the increased awareness of importance of fish for nutrition, and the strengthened economic position of fish farmers who requested further extension activities. An important product of the project is the FAO training manual for extensionists and AFS facilitators. The Aquaculture Business Development Programme of the Kenyan Government and IFAD will upscale the methodology to nine more counties in Kenya. The relatively small TCP project trained over 2 000 fish farmers through the AFS approach, thus expectations of the impact during the remainder of ABDP are very high.

The AFS approach represents a paradigm shift in agricultural extension and can be viewed as a capacity-building investment in the sector of education, information and training. Key strengths of the AFS approach can be broadly categorized as follows: the enhancement of human and social capital and a key entry point for new practices and technologies.

Women's Groups and Seaweed Cultivation in Kenya During Times of COVID-19

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Kibuyuni seaweed farmers participating in a value addition training

Recognizing the value of effective training, extension services and technical assistance to improve the livelihoods of aquaculture farmers, the Government of Kenya requested an FAO's technical assistance project, entitled "Support to the implementation of mariculture in Kenya within an ecosystem approach" (TCP/KEN/3502). One of the activities under the project was the training of farmer groups to produce seaweed, mussels, oysters, crabs and milkfish. Within the seaweed group, members enhanced their capacity to improve production, productivity and processing of seaweed.

Two species of seaweed, *Kappaphycus alvarezii* (cottonii) and *Eucheuma denticulatum* (spinosum), are grown along the south coast of Kenya, as the environmental conditions are favourable in this area. Extracts of dried seaweed are used as food thickeners and in the global pharmaceutical and cosmetic industries. Seaweed has also been used as an additive to soils, mainly in coastal areas. The culture of this aquatic plant is gradually becoming a popular, income-generating opportunity to supplement fishing, and seaweed culture is arising as a viable alternative livelihood in these communities. The objective was to promote reduction in post-harvest losses and enhance the quality of the crop with the aim of fetching higher prices in the market. To this effect, the project facilitated the construction of drying sheds with raised racks where the harvested crop could be spread to dry. In addition, the project linked the five established seaweed groups with an international company that purchased the dried seaweed.

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At low tide, the seaweed emerges from the sea

Written by:

Alice Jesse

FAO Representation to Kenya

Martin Van der Knaap

Subregional Office for Eastern Africa, Addis Ababa, Ethiopia

The project worked with five seaweed groups, namely, Mkwiro, Kibuyuni, Gasi, Nyumba Sita and Funzi, all located in Kwale county on the coast south of Mombasa. In these areas, the project supported pilot seaweed culture sites, with a specific focus on best management practices for production, post-harvest management and value addition.

The Kibuyuni Seaweed Women, one of the five groups supported by the project, has been reaping the benefits of seaweed farming. This group consists of 52 members and was registered with the Government under social services as a self-help group. The group supplies seaweed to buyers in its raw form and earns additional income from value addition for products such as juices, cookies, cakes, vegetable salads, soap bars, liquid soaps and cosmetic items. Part of their training was on best business management practices and value addition. The income generated from the sale of raw seaweed and value-added products have gradually improved the standards of living of the communities. Notably, the majority of the beneficiaries were women. With these improved livelihoods, they put food on the table, educated their children, built new houses and purchased better building materials for their homes.

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A woman gathers seaweed at low tide

Tima Mwalimu Jasho is a seaweed farmer who has used part of her increased earnings from seaweed to build a one-bedroom house which she rents out. "*We have been supported to sell 41 tonnes of seaweed, which gave us more than 13 thousand US dollars. We have been living in poverty unaware that we're sitting on something that could help us in future*", says Tima Mwalimu.

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Project staff and stakeholders celebrating the seaweed harvest in Kibuyuni, Kenya

The seaweed farming group also entered into a partnership with an international buyer who purchased and installed a baling machine. This machine works to compact the seaweed to enable easy packing into bales, which in turn reduces transport costs and fetches a higher price. The selling price of dried seaweed increased from USD 0.17 to USD 0.25 per kg, an increase of nearly 50 percent. The seaweed is mainly exported to Asia, France and the United States of America where demand has been rising. In addition to the investment in capacity building of the farmers and the engagement of the international buyer, the Government of Kenya provided infrastructural support in Kwale county. This support included construction of two seaweed stores that incorporate a section for compacting seaweed bales at Kibuyuni and Gasi fish landing sites. It also included construction of a seaweed drying shed and installation of improved seaweed drying racks at Gasi fish landing site, and provided technical support to seaweed farmers through the establishment of a station of the Kenya Marine and Fisheries Research Institute in Kibuyuni.

Although the project ended in 2017, the gains made are still evident that the pilot initiative was successful. A survey by the State Department for Fisheries, Aquaculture and the Blue Economy indicated that the subsector had increased from 120 farmers to the current number of 416 farmers. In 2016, about 50 tonnes were produced with a value of KES 1 277 490 (USD 122 275), which increased from 3 328 to 10 000 tonnes of seaweed annually with an approximate value of between KES 83 200 000 (USD 832 000) and KES 250 000 000 (USD 2 500 000). At the beginning of 2020, there were seven groups established with 416 farmers from Kibuyuni, Mkwiro, Mwambao, Nyumba Sita, Tumbe, Gasi and Funzi fishing villages. Notably, Kibuyuni Seaweed Women's group graduated from a self-help group to a cooperative society entitled the Kibuyuni Seaweed Farmers Association and registered as a Savings and Credit Cooperative Society.

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Clockwise from top left: freshly harvested seaweed showing different colour varieties; seaweed being blanched (quickly dunked in boiling water); a prepared salad of seaweed and vegetables; and seaweed soap being cut ready for packaging

To this community, seaweed is prized as gold. However, despite all these efforts, the ever-changing environmental conditions are a threat to this thriving alternative livelihood. Warmer temperatures causing a rise in sea levels have challenged the seaweed farming community in tending their farms as regularly as required, and diseases such as "ice-ice" have led to die-offs of seaweed due to stress caused by changes in temperature, salinity or light intensity.

Furthermore, the COVID-19 pandemic has hit hard, leaving the farmers in distress. The restriction measures put in place to avert the spreading of the pandemic affected the mainstay of the community. Some of the restrictions ranged from lockdown to cessation of movement to and from major cities such as Nairobi and Mombasa, which serve as markets for the majority of the produce from the various regions within the country. With the global market negatively impacted, incomes fell as export came to a halt and processed seaweed piled up in warehouses. In particular, women are vulnerable to the effects of the pandemic, as they form 90 percent of the workforce and membership of the seaweed farmer groups. Apart from the temporary lack of export possibilities, the main bottlenecks facing seaweed farmers are the lack of seeds to restock the farms and the lack of capital to invest in the upcoming season.

The Development of On-Farm Feed Management Guidelines for Trout and Carp Culture in Eastern Europe and Central Asia

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Rainbow trout farm, Lake Issyk-Kul, Kyrgyzstan

In collaboration with the Network of Aquaculture Centers in Central-Eastern Europe (NACEE), FAO has been implementing a project to review aquafeed availability and on-farm feed management in Eastern Europe and Central Asia. The project represents a part of the FAO regional initiative for Europe and Central Asia: empowering smallholders, family farms and youth, facilitating rural livelihoods and poverty reduction. The provision of high-quality aquafeeds that satisfy the nutritional requirements of the culture species and optimize growth is a prerequisite to increasing production yields, lowering production costs and improving economic returns to farmers. In many countries, high feed and feed ingredient costs and a lack of good-quality locally manufactured feeds pose a significant constraint to profitable fish production. Likewise, the relatively low levels of fish production and a concomitant low domestic demand for aquafeeds restrict investment in feed manufacturing capacity, which when combined with a lack of high-quality feed ingredients and feed additives in the region makes it difficult for domestic feed manufacturers to supply farmers with high-quality, cost-effective aquafeeds.

Written by:

Haydar Fersoy

FAO Subregional Office for Central Asia, Ankara, Turkey

Rodrigo Roubach

FAO Fisheries and Aquaculture Division, Rome, Italy

Tom Shipton

Department of Ichthyology and Fisheries Science, Rhodes University, Grahamstown, South Africa

A series of in-country studies of aquafeed use in Azerbaijan, Belarus, Hungary, Kyrgyzstan, Poland, Romania, Ukraine and Uzbekistan were undertaken and used as the basis for establishing guidelines to optimize on-farm feed management practices for carp and trout culture, and to develop recommendations to enhance feed manufacturing capacity and improve the availability of cost-effective, high-quality feeds in the region.

On 20 and 21 April 2021, a regional webinar was held to discuss the findings of the studies, present the on-farm feed management guidelines and discuss recommendations to develop aquafeed value chains. The webinar discussions established that, although all the countries in the region have access to high-quality aquafeeds, there are significant national and regional disparities in aquafeed manufacturing capacities and supply chains. While those countries that fall within the orbit of the European Union have the most established feed manufacturing sectors in terms of production scale, the use of advanced production

technologies to manufacture high-quality extruded feeds, and product quality control and marketing systems, other countries, particularly those in Central Asia, are still in the process of establishing their feed manufacturing sectors. Feed manufacturing in these countries is generally restricted to compressed pellet feed production, with extruded feeds being imported from other countries in the region. Notable exceptions include Azerbaijan and Kazakhstan, which have recently made significant investments into advanced feed manufacturing technologies to produce high-quality extruded feeds.

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Small-scale aquafeed manufacturing plant, "Issyk-Kul Plus" Aquaculture Cooperative, Kyrgyzstan

Recommendations to develop aquafeed value chains recognized the need to increase fish consumption across the region and therefore the demand for aquafeeds, improve fish production and on-farm feed management practices, and demonstrate the economic and environmental efficacy of using high-quality feeds. A number of needs were identified, including strengthening legal, institutional and policy environments through the adoption of appropriate feed standards, regulating the use of feed additives, and improving national feed/feed ingredient monitoring capacity. Market information systems for feed manufacturers, feed traders and farmers were viewed as essential to improving market access to feeds and feed ingredients; and in many countries, most notably in Central Asia, requirements to improve the technical capacity to manufacture high-quality aquafeeds through capacity building for fish nutritionists, improvements to feed formulations, and feed manufacturing technology transfers were identified. Investment support is required to provide funding to the nascent feed manufacturing sector in many countries, and the representation of the feed manufacturers' interests needs to be promoted through the development of national feed manufacturers associations.

The guidelines for feed use in carp and trout production systems in Eastern Europe and Central Asia provide farmers with practical guidance on how to select appropriate feeds and optimize their use by implementing proper on-farm feed management practices. The guidelines also introduce fish nutrition with a focus on the dietary nutritional requirements of commercially cultured carps and trout and the types of aquafeeds (live feeds, supplementary, farm-made and commercially manufactured feeds), their composition and nutritional value, and manufacture. On-farm feed management practices focus on feeding methods, feed storage and methods to optimize feed consumption (calculating feed rations, feeding frequency, assessing appetite and the feeding response), and establishing the efficacy of feeds and feed management practices through feed monitoring and the application of key performance indicators such as feed conversion ratios and growth monitoring.

SEE ALSO

Shipton, T.A. 2021. *Guidelines for feed use in carp and trout production systems in Central Asia and Eastern Europe*. FAO Fisheries and Aquaculture Circular No. 1224. Rome, FAO. **https://doi.org/10.4060/cb4640en**

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Farm raised rainbow trout (*Oncorhynchus mykiss*)

Aquaculture Development in Kyrgyzstan (2009–2021)

In Kyrgyzstan, the Department of Fisheries of the Ministry of Agriculture, Food Industry and Melioration, in collaboration with FAO, and the Ministry for Foreign Affairs, the Government of Finland have been working together to rejuvenate the aquaculture and fisheries sectors in Kyrgyzstan since 2009. Despite significant investments in production capacity that were made during the Soviet era, fish production in the Central Asian region precipitously dropped after the fall of the Soviet Union and the development of the Commonwealth of Independent States. In 2009, aquaculture and fisheries production in Kyrgyzstan amounted to just 200 tonnes, a mere 10 percent of the output recorded during the 1980s. Since then, and as a result of the project activities, national fish production increased from 200 tonnes (2009) to 5 140 tonnes (2020), representing a 17-fold increase in production. According to FAO statistics on global aquaculture production, between 2013 and 2018, aquaculture production in Kyrgyzstan increased 54 percent annually, representing a significantly higher growth rate than the 20 percent growth recorded across Central Asia and the highest in the world among those countries where aquaculture production in 2013 was more than 100 tonnes.

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Carp and trout hatchery at the "Ketmen-Dobo" Aquaculture Cooperative, Toktogul

The revitalization of the aquaculture and fisheries production sectors in the country required a holistic approach to sector development, and one that focused on the provision of institutional support to the Department of Fisheries, farmer development and technical training, fisheries research, value chain development, and the reintroduction of appropriate cost-effective production models and technologies.

Institutional support to the Department of Fisheries was provided through the development of a Strategy for Aquaculture and Fisheries Development in the Kyrgyz Republic (2019–2023), which was formally adopted by the Government. Aquaculture and fisheries legal and regulatory reviews were completed, and proposals made for the development of a "one-stop shop" for aquaculture applications. A guideline for aquaculture and fisheries applications was developed, and a new aquaculture licensing and permitting framework was formulated.

Farmer support was provided under a cooperative development model. Business management training and technical and material support were also provided to revitalize the country's fish hatcheries, aquafeed manufacturing and fish processing capacity. Seven small-scale common carp, trout and white fish hatcheries were developed – four hatcheries were commissioned for aquaculture cooperatives and three for the Department of Fisheries. The government-supported hatcheries were designed to provide fry and fingerlings to national fish restocking programmes. Production technologies for intensive aquaculture, hormone-induced breeding, spawning of common carp and trout egg incubation were successfully reintroduced in Kyrgyzstan, and demonstrably, at the end of the project, farmers and Department of Fisheries staff were able to successfully breed fish independently from project training. To support local aquafeed manufacturing and reduce feed production

Written by:

Tom Shipton

Department of Ichthyology and Fisheries Science, Rhodes University, Grahamstown, South Africa

Mairam Sarieva

FAO Representation to the Kyrgyz Republic, Bishkek, Kyrgyzstan

Haydar Fersoy

FAO Subregional Office for Central Asia, Ankara, Turkey

Junning Cai

FAO Fisheries and Aquaculture Division, Rome, Italy

costs, three small-scale feed mills (capacity: 600 kg/hr feed production) were installed. The farmers were trained to formulate and manufacture feeds using locally available feed ingredients. National fish processing capacity was enhanced through the development of four primary fish processing units that were designed for washing, gutting, filleting and simple preservation (freezing, icing).

In partnership with the University of Eastern Finland, national vocational aquaculture and fisheries training capacity was enhanced through the development of teaching curricula at the Kyrgyz National Agrarian University and in the country's agrotechnical colleges. Additionally, a scientific research programme was commissioned, focusing on limnology, aquatic biodiversity and the development of empirical fish production models to establish maximum sustainable yields in lakes and reservoirs. The research was used to provide scientific advice to support sustainable fisheries management and aquatic biodiversity conservation in the country's major waterbodies.

Ten fisher and fish farmers associations and cooperatives were established in the provinces of Issyk-Kul, Naryn, Chui, Jalal-Abad and Talas, and over 80 technical trainings, workshops and consultations were undertaken both locally and regionally on various topics of fisheries and aquaculture. A total of 1 661 technical, research and scientific officers, and farmers and fishers were trained. Within those households supported by the project, the income contribution from fish production increased from negligible levels to 20 to 40 percent of the total household income. Demonstrably, the combination of a value chain approach to development that focused on the introduction of appropriate production models based on economically viable business cases, technical support and training and the development of an enabling investor environment has resulted in significant growth in fish production and is encouraging new entrants and investment to the fish production sector.

Looking forward, there remains significant scope to further develop the aquaculture and fisheries sectors in the country. According to FAO estimations, between 2018 and 2030, annual fish production in Kyrgyzstan would need to increase by 27 000 tonnes to satisfy fish demand driven by its population growth, and to increase its per capita fish consumption to the average levels of landlocked developing countries. The project has provided a solid foundation to further facilitate the development of aquaculture and the fisheries sectors in Kyrgyzstan.

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Inauguration of the carp and trout hatchery at the "Ketmen-Dobo" Aquaculture Cooperative, Toktogul

Promoting Responsible Investment for the Sustainable Growth of Aquaculture in the Mediterranean and the Black Sea

The General Fisheries Commission for the Mediterranean (GFCM), as part of its 2030 Strategy for Sustainable Fisheries and Aquaculture in the Mediterranean and the Black Sea, is developing principles to promote responsible investment in aquaculture. The aim of these principles is to help create a more enabling environment for responsible investment in aquaculture, support the Blue Transformation of aquatic food systems in the region, and enhance the development benefits of such investments for the people of Mediterranean and Black Sea countries. Blue Transformation aims at accelerating a viable, healthy and sustainable development of the wider aquatic food systems, ensuring thus that aquaculture contributes to sustainable food production, alleviates poverty and generates income for farmers and investors.

The promotion of innovative financial mechanisms, including blended finance, is critical because the growth of aquaculture in the region requires a substantial input of capital. For the Blue Transformation of aquaculture to occur, the sector needs to identify responsible investment principles to guide public and private financial support towards activities that have the potential to increase the social dividend of aquaculture, establish a paradigm of a new corporate ethos in the wider food industry, and support efforts for the achievement of the Sustainable Development Goals (SDG).

The objective of these principles is to act as a tool for national and international development organizations and respective financial institutions, to better provide responsible investment in aquaculture, to guide the development of related innovative financial mechanisms, and to attract private capital for the sustainable growth of the sector. The principles will build on existing instruments to provide innovative and sector-specific guidance.

Written by:

Houssam Hamza

General Fisheries Commission for the Mediterranean (GFCM) of FAO

Philippos Papageorgiou

National Fisheries Development Program, Kingdom of Saudi Arabia

Yannick Fiedler

FAO Fisheries and Aquaculture Division, Rome, Italy

Georgios Paximadis

Linda Fourdain

General Fisheries Commission for the Mediterranean (GFCM) of FAO

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Oysters (*Crassostrea gigas*) farmed in the lagoon of Bizerte, Tunisia

Mainstream principles for responsible investment, to which an increasing number of global investors, private equity funds and commercial financial institutions adhere, require stringent environmental, social and governance screening procedures. But global investors and private equity funds may focus more on medium and large businesses due to better financial return prospects and risk management mechanisms.

Because of the socio-economic importance of micro, small and medium enterprises in the Mediterranean and the Black Sea region and their pivotal role in the blue economy of the region, a wide-ranging policy and strategic approach is needed. The trend towards responsible investment in aquaculture should bring better investment opportunities for developing countries where aquaculture represents a viable method for sustainable blue food production and the creation of skilled youth employment.

Development of Principles for Responsible Investment in Aquaculture in the GFCM area of competence

The GFCM conducted an online multi-stakeholder consultation (survey) to understand perceptions, uncover concerns, and identify aspirations related to aquaculture and responsible investment (April – May 2021). In total, 115 selected industry stakeholders and experts from 25 countries participated. The results of the consultation

were presented at the first expert consultation workshop in the region (1 July 2021). The aim of the online workshop was to initiate a constructive dialogue among relevant stakeholders and experts, laying the foundations for the subsequent development of Principles for Responsible Investment in Aquaculture (PRIAq) in the Mediterranean and Black Sea. In this context, the objectives were to: (i) better identify the strategic framework and governing PRIAq; and (ii) support the GFCM towards the proposal of a roadmap for the development of PRIAq. The following topics were presented at the session to better understand the need to develop the PRIAq:

- Overview of the process for developing principles for responsible investment in agriculture and food systems;
- Overview of the sustainable blue economy finance principles, with a focus on aquaculture-related principles; and
- Summary of the main findings of the online consultation on developing the concept of responsible investment in aquaculture.

The presentations were followed by two panel discussions with 11 selected experts, covering a wide range of stakeholder types and a fair representation of the GFCM area of application:

PANEL 1: Aquaculture beyond food security (i.e. how PRIAq can support the blue economy and the SDGs).

PANEL 2: Responsible investment in aquaculture as a driver for growth in the Mediterranean and Black Sea.

In total, more than 100 selected experts participated in the workshop and arrived to the following conclusions:

- PRIAq can prove to be an effective tool towards the Blue Transformation of aquaculture in the region.
- PRIAq criteria can help by defining and thus endorsing aquaculture as a sustainable activity assessed through Environmental, Social, Governance (ESG) criteria.
- The application of PRIAq could help improve the social acceptance of the industry and reduce SDG and corporate social responsibility related costs (especially for micro, small and medium enterprises).
- Endorsement and application of PRIAq could act as investment incentives not strictly based on financial returns, but also on the direct or indirect contribution of the investment towards the SDGs.
- The endorsement and application of PRIAq should not add a hurdle to an already highly environmentally sustainable food production sector which has more certifications and ESG regulations as a minimum operational requirement than any other animal protein production sector. The European Union, in particular, already sets conditions for environmentally sustainable aquaculture through legislation, such as the Water Framework Directive, the Marine Strategy Framework Directive, the Common Fisheries Policy and the Strategic Environmental Assessment Directive.
- PRIAq criteria need to be sufficiently broad so as to include many species, environment types and systems of aquaculture. In countries where aquaculture is mostly a subsistence activity, it is important to take into account development goals in addition to strict ESG criteria. In those cases, an emphasis on governance is especially vital as nurturing cooperative systems such as producer organizations, cooperatives and joint marketing schemes may be essential to both the economic development and ESG compliance of the sector.
- PRIAq should not add an additional layer in the regulatory framework, but rather enable the relevant international and national development organizations and financial institutions to facilitate their selection process and align aquaculture investment to the SDGs.

In conclusion, the development of PRIAq is expected to provide a toolbox for national and international development organizations and respective financial institutions to better design and channel blended finance to aquaculture, and to effectively attract and/or guide the necessary capital towards the sustainable growth of the sector in the region.

A New Aquaculture Project in War-Affected Yemen to Strengthen Livelihood in Rural Areas to Improve Food Security

With its extensive coastline, Yemen used to be the second-largest fish-producing country in the Arabian Peninsula, ranking just after Oman. Before the current political crisis, the national fishery industry was producing more than 220 000 tonnes of fish annually, with a significant part of it being exported. Today, this figure has fallen to 131 308 tonnes. In the meantime, the average fish supply has fallen from 5.5 to 3.2 kg/capita per year, which is not only much lower than the global average of 20.5 kg/capita per year but also much lower than the World Health Organization recommendation for a healthy diet. In Yemen, artisanal fisheries dominate the marine capture fisheries subsector, accounting for almost 98 percent of the total aquatic food production, whereas the development of aquaculture is still very limited.

Indeed, aquaculture in Yemen has yet to fulfill its potential. Established in 2004, the privately owned Ba-Musallam farm, north of Hodeidah city, had long been the only successful shrimp (*Penaeus indicus*) farm in the country, producing approximately 400 tonnes of shrimp per year; however, in 2014 it was closed by military operations. In 2021, only one aquaculture company is reported as having commercial production – the Al-Amery fish farm, established in 2013 in Hadramout, in the south of Yemen, is producing 10 tonnes of Nile tilapia (*Oreochromis niloticus*) annually, most of which was exported to Saudi Arabia.

The ongoing conflict and the lack of an enabling environment and a national development plan are among the main reasons explaining the limited development of the aquaculture sector in Yemen. Aquaculture development planning should consider the lessons learned and achievements from past experiences, particularly the assessment and analysis of national stakeholder needs and constraints, institutional and technical capacities, the regulatory and legislative framework, financing and investment opportunities, research and technologies, as well as the environment, species and market.

Written by:
Abdulsalam AlKawri
Hussein Gadain
FAO Country Office for Yemen
Lionel Dabbadie
FAO Subregional Office for the Gulf Cooperation Council States and Yemen, Abu Dhabi, United Arab Emirates

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Various fish being sold at a fish market at Seerah centre, Aden

Aquaculture development is considered as a priority in Yemen's Strategic Vision 2025, and opportunities for its development include suitable locations along the Red Sea coast and in some areas in the Gulf of Aden, especially for shrimp culture, as well as the availability of large areas of low-lying unused coastal land. The potential of integrated agriculture-aquaculture is also largely untapped in most rural areas, even though it could help build resilience in some areas.

Funded by the World Bank, the new project entitled "Yemen Food Security Response and Resilience Project – P176129" will set the basis for a renewed engagement in the sector by implementing an aquaculture feasibility study and a needs assessment, which should help build the much needed enabling environment for aquaculture.

The study will look at opportunities to enhance aquaculture livelihoods and propose safety nets to local communities in order to contribute to Yemen's post-conflict and post-COVID-19 crisis recovery. It will assess the sector-wide needs for rehabilitating coastal aquaculture, and will develop an action plan to support sustainable coastal aquaculture as well as integrated agriculture-aquaculture farming systems using specific technologies such as aquaponics. The study will include a value-chain analysis that will look at identifying the capacity needs of stakeholders (e.g. fish farmers, relevant government agencies, cooperatives and local non-governmental organizations), as well as existing facilities (e.g. cold storage and processing plants).

The project will contribute greatly to the development of aquaculture in the country, and more importantly, it will help improve the socio-economic status of beneficiary communities through increased food production and livelihood opportunities.

A Comprehensive Training on Fisheries and Aquaculture Statistics

Aquatic food has always been an important commodity in the United Arab Emirates, with current per capita consumption over 26 kg. An important share of the aquatic food products being consumed in the country originates from imports, as domestic production (over 75 000 tonnes in 2019) is not sufficient to meet the demand. The aquaculture sector contributed 3 048 tonnes in 2020, a major increase from 2010 when the production was less than 200 tonnes. This is the outcome of a strong political will and strategy to increase domestic production, create local employment and generate economic opportunities.

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Integrated desert fish farm in Al Ain (Abu Dhabi emirate) using fish effluents to produce Azolla plants fed to livestock

To better monitor its achievements and plan its actions, the Government of the United Arab Emirates decided to improve its statistics collection and reporting. There is, indeed, a global need for timely, reliable and comprehensive fisheries and aquaculture statistics. This need has never been more acutely felt than at present, when most countries are engaged in the implementation of national, regional and international plans aiming at more effective monitoring and management of sustainable capture fisheries and aquaculture.

This project, implemented by FAO and the Ministry of Climate Change and Environment as well as the Federal Competitiveness and Statistics Center of the United Arab Emirates, commenced with a five-day comprehensive online training from 13 to 20 September 2021. The course provided a broad overview of aquaculture and capture fisheries statistics, as well as marketing data, trade and description on how food balance sheets for fish and fish products are calculated.

In order to make the most of the training, the Regional Commission for Fisheries (RECOFI) Member States were also invited to attend the online event. The training involved twelve experts in the various dimensions of fisheries and aquaculture statistics, in addition to the senior officers of the Regional Office for the Near East and North Africa (RNE) and the Subregional Office for the Gulf Cooperation Council States and Yemen (SNG). The event benefitted 95 participants from the United Arab Emirates as well as all the other states in the region. It will now be followed by practical training sessions.

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Tilapia (*Oreochromis* sp.) produced in an integrated desert fish farm in Al Ain (Abu Dhabi emirate)

Written by:

Stefania Vannuccini

FAO Fisheries and Aquaculture Division, Rome, Italy

Rumaitha Abdulaziz Alshehhi

Ministry of Climate Change and Environment, United Arab Emirates

Lionel Dabbadie

FAO Subregional Office for the GCC States and Yemen, United Arab Emirates

Lessons from Chile's Artisanal Fishers and Small-Scale Aquaculture Farmers as they Confront Climate Change

Background

Men and women engaged in artisanal fisheries and small-scale aquaculture contribute significantly to food security and nutrition, poverty alleviation and the sustainable use of natural resources. Global awareness and action are crucial to support these men and women, strengthen their capacities and incorporate them into territorial development agendas.

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Seven women from the artisanal fishers' union of Caleta Coliumo "cultivate" seaweed *Agarophyton chilensis*, commonly known as pelillo, as a way of diversifying productive activities and adapting to climate change

Climate change is a reality for the entire planet, and Chile is no exception. The country has a high degree of vulnerability to climate change, and while many productive sectors face profoundly impacted conditions, artisanal fishers and small-scale fish farmers are among the most severely affected because of both their geographical locations and their economic status (IPCC, 2014; Cubillos Santander *et al.*, 2021; FAO and CESSO, 2021). Thus, actions that support and promote the adaptation of this sector are necessary to address climate change and other related issues (FAO, 2018).

The pilot project "Strengthening the adaptive capacity to climate change in the fisheries and aquaculture sector of Chile" was launched in 2017 with the goal of meeting this challenge. The objective of the project, which came to an end in July 2021, was to reduce vulnerability and increase the capacity to adapt to climate change in Chile's small-scale fisheries and aquaculture sector.

Four vulnerable and representative pilot sites – coves located in different regions of the country – were selected as locations for carrying out replicable and scalable interventions.

The selected coves were Caleta Riquelme in the Tarapaca region, Caleta Tongoy in the Coquimbo region, Caleta Coliumo in the Biobío region, and Caleta El Manzano-Hualaihue in the Los Lagos region. The project, the first of its kind in Chile (FAO, 2020), was executed by the Undersecretariat of Fisheries and Aquaculture and the Ministry of the Environment and implemented by FAO, with funding from the Global Environment Facility.

Written by:

José Aguilar-Manjarrez

Laura Naranjo Báez

FAO Regional Office for Latin America and the Caribbean Santiago, Chile

Ricardo Norambuena Cleveland

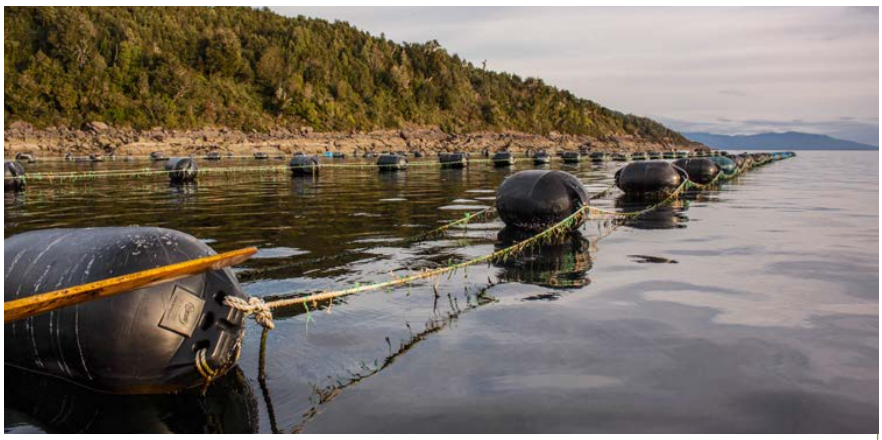
Centro COPAS Sur-Austral, Universidad de Concepción

Key results

Prior to its inception, the project identified the following barriers to adaptation: (i) institutional weaknesses; (ii) low adaptive capacity of local livelihoods; and (iii) low level of awareness or unclear appreciation among coastal communities of the impacts of climate change. To overcome these barriers, the project generated actions and developed capacities for climate change adaptation at the national, regional and local levels through three main components: (i) strengthening public and private institutional capacity for effective climate change adaptation; (ii) improving the capacity for adaptation to climate change of local fisheries and aquaculture communities; and (iii) awareness-raising and increasing knowledge on climate change in fisheries and aquaculture communities.

Seven inter-institutional working groups were created that brought together key actors in a common workspace; an interoperable information system was designed to systematize fishing, aquaculture and climate change variables; and more than 400 researchers, public officials and decision-makers were trained in adaptation to climate change in the fisheries and aquaculture sector.

More than 140 artisanal fishers and small-scale aquaculture farmers were trained in adaptation to climate change.



Experimental aquaculture activities were implemented in the pilot sites as a means of encouraging adaptation to climate change

Top left: cultivation of Sea Chicory (*Chondracanthus chamissoi*) in Riquelme; *Top right*: cultivation of red seaweed (*Agarophyton chilensis*) in Coliumo; Center left: cultivation of Sea Chicory (*Chondracanthus chamissoi*) in El Manzano-Hualaihué; *Center right*: cultivation of Choro mussel (*Choromytilus chorus*) in Riquelme; *Bottom left*: collection of Chilean mussel seeds (*Mytilus chilensis*); *Bottom right*: view of the El Manzano Hualaihué Chilean mussel seed (*Mytilus chilensis*) collection center

Special attention was given to the participation of women, who accounted for more than 50 percent of trainees. In addition, a participatory environmental monitoring training programme was created to promote the measurement and recording of critical environmental variables.

A total of 26 experimental initiatives to explore new adaptation practices in the pilot coves were conducted, including: (i) a novel proposal for a certification that indicates how prepared or adapted a cove is to the impacts of climate change; (ii) the identification of alternative ways to process bycatch; (iii) local production of value-added fishery products; (iv) development strategies for sustainable tourism to create complementary activities for artisanal fishers and small-scale farmers; and (v) experimental small-scale aquaculture of Chilean mussel, choro mussel, Japanese oyster and red seaweed, and the improvement of mussel seed collection with a view to exploring productive alternatives for coastal communities.

The project implemented communication and training initiatives for more than 5 000 artisanal fishers, small-scale

farmers and the general public, established a communication strategy that included efforts to contribute to new public policies, and published a vast amount of academic and informative material, including one policy brief; four regional reports (one from each cove) and one general technical report systematizing best practices and lessons learned; 32 monthly newsletters; 96 media appearances; a project brochure; a basic guide on climate change; a manual for an environmental monitoring system; a practical manual on climate change for artisanal fisheries and small-scale aquaculture in Chile, with a facilitator's guide; four special interest tourism strategies; five manuals on experimental aquaculture in management areas; five manuals for the elaboration of value-added fisheries and aquaculture products; and a children's game on climate change related to fisheries and aquaculture.

Other achievements include high-quality audio-visual material, contributing to the dissemination and understanding of the relevant subjects, experiences and knowledge of the main actors; an inter-institutional seminar (www.fao.org/chile/noticias/detail-events/es/c/1390751); project closure seminar (www.fao.org/americas/eventos/ver/es/c/1410517); and a documentary video including testimonies about the project's impact (www.youtube.com/watch?v=IyS3Z25zpBk). In addition, project closure workshops involving beneficiaries and national, regional and local authorities were held in Tongoy and El Manzano coves.

Lessons learned

Lessons learned help to identify the gaps that need to be bridged through action, as well as strengths for further climate change adaptation initiatives. Some of the key lessons learned were, among others:

- Training of authorities and civil servants on climate change should continue. Ongoing training contributes to building knowledge, critical mass and networks to facilitate the design and implementation of public policies for the adaptation to climate change in the fisheries and aquaculture sector.
- The implementation of adaptation measures in the territory requires an initial outreach phase to integrate the local knowledge of fishers, shellfish divers, aquaculture farmers, and shellfish and seaweed collectors and to identify the specificities and needs of beneficiaries. This process should be implemented by capacity-building facilitators with relevant skills, using appropriate language.
- It is essential to engage the communities, their representatives and authorities. Local actors must be jointly responsible for the intervention initiatives. It is also expected that the communities will have access to institutional and financial support to sustain them over time, to the extent that resources are available.
- The unique attributes of each fishing cove, in terms of extractive cultures (type of resources, fishing gear and/or fishing equipment) and organizational capacities (grassroots organizations, supra-organizations), were identified for the purpose of better understanding and leading the implementation of adaptation actions.
- Small-scale aquaculture was recognized as an opportunity for productive diversification and a concrete way to adapt to climate change. Artisanal fishers who have been affected by decreases in their catches because of changes in the behaviour of resources have accepted the challenge of transitioning from fishing to aquaculture.
- The design and implementation of awareness-raising activities and training on climate change for artisanal fishers and small-scale aquaculture farmers should consider the identification of climate hazards and risks in their territory and, in parallel, the status of the resources and environment that sustain their livelihoods.
- An important step is the appropriate participatory assessment of the risks and vulnerability of local fisheries and aquaculture to climate change. Such a step should explicitly include the quality of fisheries and environmental management. This process should recognize the individual and collective responsibilities from which improvements and opportunities for adaptation can be identified.

Conclusions and recommendations

The project included a gender approach to increase the economic benefits and create opportunities for both women and men and, in turn, increase the presence of women in these productive activities, and their membership in associations and participation in decision-making.

©FAO/Marcelina Novoa (photo taken before the COVID-19 pandemic)

Women in Caleta Tongoy participate in a first seeding of Japanese oysters, an aquaculture activity that was historically carried out mainly by men

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Devora García (*left*), president of the "Acuipesca Tongoy Mujeres" Cooperative, and Elizabeth Almonacid (*right*) receive a certificate marking the establishment of the cooperative from Alicia Gallardo Lagno, Undersecretary of the Ministry of Fisheries and Aquaculture (*centre*)

Project activities provided the authorities and communities involved with the capacity and tools to face the transformation challenge required to adapt to future climate scenarios. Moreover, the project's design and intervention approach can be replicated in other coastal communities in Chile and Latin America.

As part of the project, a sustainability strategy was prepared and discussed among relevant institutions with the purpose of providing continuity for project activities and laying the groundwork for similar efforts in other coves in Chile. Implementation of the sustainability strategy requires a high degree of commitment and leadership, especially in the context of the COVID-19 pandemic and the emergence of new priorities. However, it is essential to scale-up adaptation efforts in the pilot coves for the benefit of all coastal communities in Chile and to ensure their sustainability. Efficient and effective coordination and engagement with national institutions, policies and programmes will be crucial to ensure systematic uptake of project recommendations, methodologies, systems, results and best practices.

The strategy for sustainability and replicability of the outcomes and achievements of the project requires adequate and appropriate policies for their effective implementation. The main aspects requiring policy support include: (i) plans and programmes for artisanal fisheries and small-scale aquaculture; (ii) training at the national and local levels; (iii) climate and oceanographic information; and (iv) gender mainstreaming.

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Webinar on Inland Aquaculture in the Maghreb Countries

The webinar "Inland aquaculture in the Maghreb countries: potentialities and perspectives" was organized on 2 and 3 August 2021 by the FAO Subregional Office for North Africa. It was attended by more than 90 participants from the five North African countries (Algeria, Libya, Mauritania, Morocco and Tunisia), as well as other countries from the wider Near East and North Africa region. Inland aquaculture stakeholders included government officials, private investors, scientific researchers, professional organizations, FAO officers and representatives of the Arab Maghreb Union.

This event was an opportunity for the countries to present the current status of the implementation of the recommendations made during the Fifth Edition of the Maghreb Aquaculture Days (held in Ifrane, Morocco, in 2019) and to share up-to-date information on freshwater aquaculture. The webinar also helped strengthen the cooperation between the countries.

During the two days, innovative and successful experiences of freshwater aquaculture were presented through thirteen oral presentations and five video broadcasts. The presentations mainly focused on aquaculture production systems, especially tilapia farming, cultivation and processing of spirulina, the use of new ingredients in aquaculture feed (e.g. insect larvae), integrated agriculture-aquaculture systems, urban aquaponics and the potential of multitrophic aquaculture in North Africa.

Participants agreed that the involvement of a subregional body such as the Arab Maghreb Union (AMU) is essential for immediate actions to be taken to support the development of inland aquaculture in the subregion. Therefore, participants reiterated their suggestion made at the Fifth Edition of the Maghreb Aquaculture Days to create two working groups dedicated to inland aquaculture and marine aquaculture under the supervision of AMU in order to promote partnerships as well as investments in the sector. In addition, it was recommended to set up a virtual network bringing together all the stakeholders to facilitate the implementation of the meeting recommendations, including a more effective collaboration and sharing of information. One recommendation shared by the five North African countries was related to the need of improving the regulatory framework by reviewing the legislations in force for inland aquaculture. The importance of farming technologies, innovation and species diversification to support the development of inland aquaculture and its value chain was also highlighted by participants.

This webinar represented an opportunity for participants to identify the main issues to be addressed during the Sixth Edition of the Maghreb Aquaculture Days that will be organized in 2022 in Mauritania.

Written by:
Asma Jlassi
Esma Bounouh
Emna Derouiche
Valerio Crespi
FAO Subregional Office for North Africa, Tunis, Tunisia

SEE ALSO

Report of the Fifth Edition of the Maghreb Aquaculture Days (Ifrane, Morocco, 2019). Aquaculture continental: situations and perspectives.
PDF **www.fao.org/3/ca9260fr/CA9260FR.pdf**

FAN article on the Fifth Edition of the Maghreb Aquaculture Days: Focusing on Freshwater Aquaculture Sector at the Fifth Edition of the Maghreb Aquaculture Days.
PDF **www.fao.org/3/ca8302en/CA8302EN.pdf**

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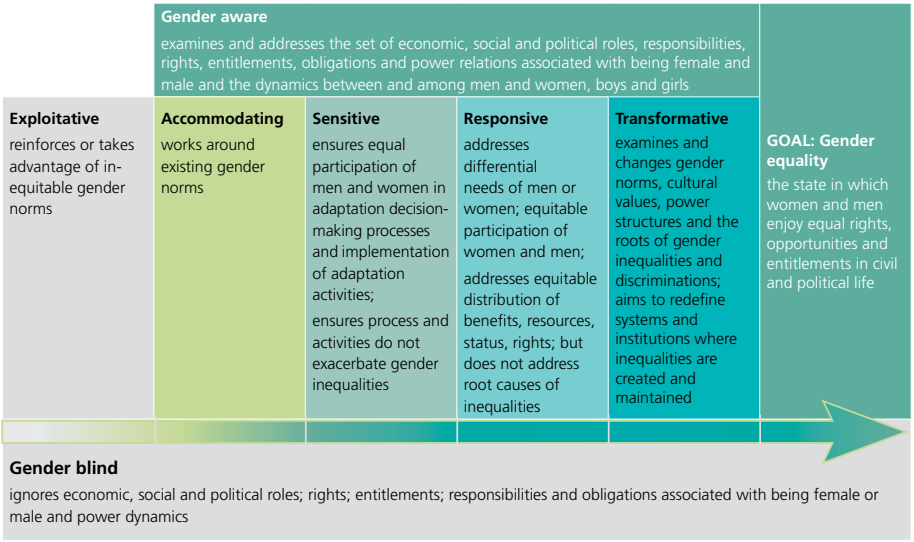
Gender Transformative Approaches in Aquaculture: A Tool to Address Root Causes of Gender Inequalities and Discrimination

Gender Transformative Approaches (GTAs) are a progressive tool both to examine and address the root causes of gender inequality and discrimination beyond simply treating the superficial symptoms, and to redress power imbalances at individual and societal levels. GTAs are adaptable to any context, including aquaculture development. Achieving gender equality is crucial for aquaculture to reach its full potential and ensure that no one is left behind.

INFOGRAPHIC 1 – Gender integration continuum for adaptation plans and projects



Gender approaches: gender blind, gender aware and gender transformative

Several strategies exist to redress the lack of access to resources, land and training for women and achieve gender equality in rural communities. The different strategies can be understood taking into consideration the Gender Integration Continuum, developed by the Interagency Gender Working Group. The continuum categorizes approaches based on how they treat gender norms and inequities in the design, implementation and evaluation of programmes or policy.

Gender blind initiatives do not provide any proactive consideration of the larger gender environment and specific gender roles affecting beneficiaries. Projects of this kind ignore gender considerations altogether. In contrast, gender aware programmes and policies examine and address the anticipated gender-related outcomes during both design and implementation. Incorporating gender awareness within initiatives is important for understanding the set of economic, social and political roles, the rights and entitlements associated with being female and male, and the dynamics between men and women.[1] In the context of gender aware initiatives, there are different degrees of intervention and types of strategies. Specifically, these are gender accommodating, gender sensitive, gender responsive and gender transformative strategies (see Infographic 1).[2]

Written by:
Maria Grazia Cantarella
Roxane Misk
FAO Fisheries and Aquaculture Division, Rome, Italy

1. Rottach, E., Schuler, S.R. & Hardee, K. 2009. Gender perspectives improve reproductive health outcomes. New evidence. pp. 6–8 www.prb.org/wp-content/uploads/2021/01/030520210-genderperspectives.pdf;
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Gender transformative approaches have been developed for years and have gained traction in the past decade in the context of food security and agriculture. GTAs create an enabling environment for gender transformation by going beyond just including women as participants,[3] promoting opportunities for women to increase their social and political influence in the community and power inequities between people of different genders. GTAs can be identified from six core characteristics. They are those that:

1. Address the underlying social norms and attitudes that perpetuate gender inequalities. These are embedded in discriminatory social, economic, and formal and informal institutions and policies.
2. Use participatory approaches to facilitate dialogue, trust and behaviour change at various levels.
3. Require critical reflection on deep-rooted social and gender norms and attitudes in order to challenge power dynamics and bring about shift at all levels.
4. Explicitly engage with men and boys to address concepts of masculinity and gender.
5. Engage with norm holders (traditional and religious leaders, lead farmers, local authorities, etc.).
6. Are flexible and may be adapted to different contexts.[4]

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A group of women feeding fish and testing water in Teknaf Upazila, Bangladesh

While all gender aware initiatives may generate positive outcomes with regard to gender integration and gender equality, GTAs are considered the most advanced, permanent and an effective long-term strategy.

Implementation of GTAs in aquaculture

In the aquaculture sector, predominant gender and socio-religious norms limit women's ability to engage and benefit fully from various aquaculture and capacity-development opportunities.[5] Integrating GTAs in the design of a technical aquaculture programme allows to directly address such harmful norms, increasing women's economic empowerment, decision-making power, confidence and involvement in aquaculture production, which have been proved to be linked to increasing productivity and income from fish ponds.[6] Their integration also leads to positive outcomes in terms of adoption of technology, improved farming practices and benefits for women, such as greater control over production and self-efficacy and better acceptance by other members of the community of improved farming practices.[7]

A recent study conducted by WorldFish in Bangladesh, and soon to be published, has shown early positive results in addressing gender biases in aquaculture through GTAs. The initial project targeted women with the development of a new technology, specifically a new kind of net to harvest fish, enabling women to gather nutrient-rich fish with less time and labour. The introduction of the technology alone was not able to resolve the social stigma associated with women catching fish; hence, gender transformative tools were introduced to create dialogue and critical reflection at the individual, household and community levels and to discuss how current norms limited individual and family well-being. Consequently, the involvement of women in fish farming was gradually accepted by men and communities, collaboration among women and men increased, and acceptance of technology use by women grew significantly.[8,9]

Other studies conducted in small-scale capture fisheries have also produced significant results in advancing gender equality after implementing the GTAs. A study conducted in the Barotse floodplain in Zambia compared the assessment of gender accommodative and gender transformative approaches combined with research testing

2. **Nelson, S. & Hill, C.** 2019. Gender in adaptation planning for the agriculture sectors: Guide for trainers. Rome. pp. 40. **www.fao.org/3/ca7088en/ca7088en.pdf**
3. Health Communication Capacity Collaborative. *Gender Transformative Approaches*. An HC3 Research Primer. **www.healthcommcapacity.org/wp-content/uploads/2014/08/Gender-Transformative-Approaches-An-HC3-Research-Primer.pdf**
4. **FAO, IFAD & WFP.** 2020. *Gender transformative approaches for food security, improved nutrition and sustainable agriculture: a compendium of fifteen good practices*. Rome. **www.fao.org/3/cb1331en/CB1331EN.pdf**
5. **FAO.** 2017. *Women's empowerment in aquaculture in Bangladesh and Indonesia: Insights from four case studies.*
6. **Murshed-e-Jahan, K. *et al.*** 2010. The impacts of aquaculture development on food security: lessons from Bangladesh. *Aquaculture Research*, 41(4): 481–495.
7. **Farnworth, C.R., Sultana, N., Kantor, P. & Choudhury, A.** 2015. *Gender integration in aquaculture research and technology adoption processes: lessons learned in Bangladesh.* Penang, Malaysia, WorldFish. Working paper: 2015–17. **https://digitalarchive.worldfishcenter.org/bitstream/handle/20.500.12348/233/3883_2015-17.pdf?sequence=1&isAllowed=y**
8. **FAO.** 2021. *Learning from experiences in implementing gender transformative approaches in the fisheries and aquaculture sectors.* **www.fao.org/gender/projects/projects/fr/c/1392397/**
9. **Österblom, H., Wabnitz, C.C.C., Tladi D. *et al.*** 2020. Towards ocean equity. Washington, DC, World Resources Institute. pp. 18. **www.oceanpanel.org/sites/default/files/2020-04/towards-ocean-equity.pdf**

fish processing technologies with women and men value chain actors to help reduce post-harvest losses. The GTA consisted in the use of tailor-made drama skits on gender-related issues adapted to the context of small-scale fisheries in Zambia, namely, gender roles and responsibilities, power, support and working together, and decision-making. These skits remained humorous and fun while at the same time transmitting serious and sensitive subject matter. The theatre activity was followed by a facilitated discussion, structured by guiding questions that later sparked reflection and raised questions also at the community level. The comparison with gender accommodative approaches showed that GTAs resulted in a significant change in attitudes and an increase in women's decision-making power regarding the use of income generated from processing and trading fish.[10]

©FAO/K. Coates

Fish farmer in Teknaf Upazila, Bangladesh

Both these examples show that GTAs are a powerful tool to empower women and girls to realize profound changes and achieve gender equality in fisheries and aquaculture communities. It must be emphasized, however, that these changes take place slowly and require time commitment, a gender-aware "mind-set" on behalf of the project implementers, starting at the request and design stage and involving multi-disciplinary teams. The engagement, contribution and support of men and the entire family – especially the in-laws – is also a key aspect to take into account. In addition, implementation of GTAs in development programmes encounters resistance from institutions failing to recognize the linkages between their sector, gender equality and food security. For this reason, GTAs need to be further developed and supported to produce data and statistics that assert their value and importance in fighting gender inequalities and discrimination in aquaculture.

What is FAO doing?

FAO is working to give more prominence to GTAs and to promote them throughout its work. Beside FAO's commitment to systematically integrate a gender perspective and respond to the different needs of women and men in all its normative and technical work, the **FAO Policy on Gender Equality** stresses the commitment of the Organization to pursue integrated and transformative approaches that address the root causes of existing inequalities and promote inclusive agricultural and rural development.

Emphasizing its importance, gender will be specifically discussed at the upcoming 11th Session of the Subcommittee on Aquaculture, in direct response to a request for Members to highlight the topic. In addition, in the recent Shanghai Declaration, unanimously adopted by the participants of the Global Conference on Aquaculture Millennium +20, gender issues were mainstreamed in various dimensions of aquaculture development, e.g. aquatic food and nutrition, equitable livelihoods, decent work and socially responsible enterprises, opportunities for youth, data and information collection, and monitoring and evaluation systems. Indeed, the Shanghai Declaration identified women's empowerment as one of ten strategic priorities. Overall, this highlights the gender-based constraints that prevent women to benefit equally from their work, the gender-blind policies that do not distinguish the different needs of women and men in development, and the lack of secure and equitable human and labour rights. This increased attention of the role and contribution of women, their empowerment and the need for gender-transformative change in aquaculture shows that these issues are the responsibility of everyone in the sector.

SEE ALSO

CGIAR Collaborative Platform for Gender Research. 2019. *Implementing gender transformative approaches in agriculture. A discussion paper for the European Commission.* **www.kit.nl/wp-content/uploads/2020/08/Gender-Transformative-Approaches-in-Agriculture_Platform-Discussion-Paper-final-1.pdf**

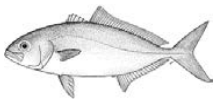
Global Conference on Aquaculture, 2020. *Shanghai Declaration: Aquaculture for food and sustainable development.* Global Conference on Aquaculture, 22–25 September 2021, Shanghai, China. **https://aquaculture2020.org/uploads/shanghai-declaration-EN.pdf**

10. Cole, S.M., Kaminski, A.M., McDougall, C., Kefi, A.S., Marinda, P.A., Maliko, M. & Mtonga, J. 2020. Gender accommodative versus transformative approaches: a comparative assessment within a post-harvest fish loss reduction intervention. *Gender, Technology and Development*, 1–18. https://cgspace.cgiar.org/handle/10568/108936

FAO Releases a Prototype of a New Global Information System for Aquatic Diversity

Introduction

It is well established that biodiversity underpins all agriculture production. Failure to adequately conserve and sustainably utilize biodiversity in our food systems compromises the capacity of these systems to deliver current and future food security. This equation applies as much, if not more, to aquatic food systems as it does to terrestrial. The first global assessment of the status of aquatic genetic resources (AqGR) for food and agriculture clearly identified that there is currently a paucity of data and information on the AqGR (both animal and plant) utilized in aquaculture systems and on their wild relatives (FAO, 2019). This lack of information constrains the development of strategies, policies and legislation for effective management of these resources. The global assessment also identified the absence of a standardized terminology used to describe AqGR.



In response to the needs and challenges identified in the global assessment, the Commission on Genetic Resources for Food and Agriculture, at its 17th Session, requested FAO to develop a Global Plan of Action (GPA) for AqGR. A draft GPA, prepared by FAO following a broad consultative process, was recently endorsed by the Commission at its 18th Session and is expected to be adopted by the FAO Council at its forthcoming 168th Session. Access to information and particularly the development of indicators of the status of AqGR is fundamental to the implementation and monitoring of the GPA.

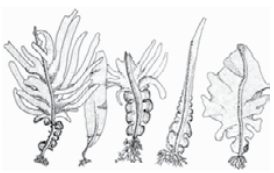
There are a range of international instruments which target the effective management and sustainable use of genetic diversity including the Sustainable Development Goals (SDGs), most specifically SDG target 2.5 (which focuses on the maintenance of genetic diversity),[1] and the strategic plans of the Convention on Biological Diversity. Using SDG target 2.5 as an example, indicators of progress against the 2020 target did not explicitly exclude AqGR but, in reality, they were not factored into the monitoring of progress towards the target, principally due to the absence of information on the global status of these resources. Suitable information sources already exist for plant and animal genetic resources used in terrestrial agriculture but are lacking for AqGR.[2]

For the reasons outlined above, the development of an information system that can provide a knowledge base accessible to key stakeholders in aquaculture and aquatic resource management is critical to enabling the development of strategies, policies and legislation needed to transform the management of AqGR to support the expansion of sustainable aquaculture production and secure the future supply of aquatic food.

With the support of the Government of Germany, FAO is working to address this key knowledge gap through the development of a global information system for AqGR known as AquaGRIS. This article summarizes the status of this information system and identifies some of the future applications among key stakeholders in AqGR. In developing a global information system, it should be recognized that a few national information systems already exist. However, these are each developed for different purposes with varied objectives. They have different structures, utilize different data and nomenclatures on AqGR and provide different information. Thus AquaGRIS will also have as a core objective to harmonize various information sources on AqGR and to standardize some of the key descriptors of AqGR. The latter is achieved through the adoption of terminology around "farmed types" as described in an earlier *FAN* article (Mair and Lucente, 2020).

Structure of AquaGRIS

FAO released a prototype of AquaGRIS in November 2021. Figure 1 outlines the structure of this prototype. The principal data source for AquaGRIS is a purpose-designed questionnaire that collects country data at three levels. Data are collected at the level of species, primary farmed types and secondary farmed types. As outlined by Mair and Lucente (2020), primary farmed types reflect the status of domestication and secondary farmed types relate to applications of value-adding technologies such as monosex or polyploidy. The questionnaire includes questions related to the origin, nomenclature, characteristics, associated risks to the environment, production and production trends, introductions and transfers, and supply

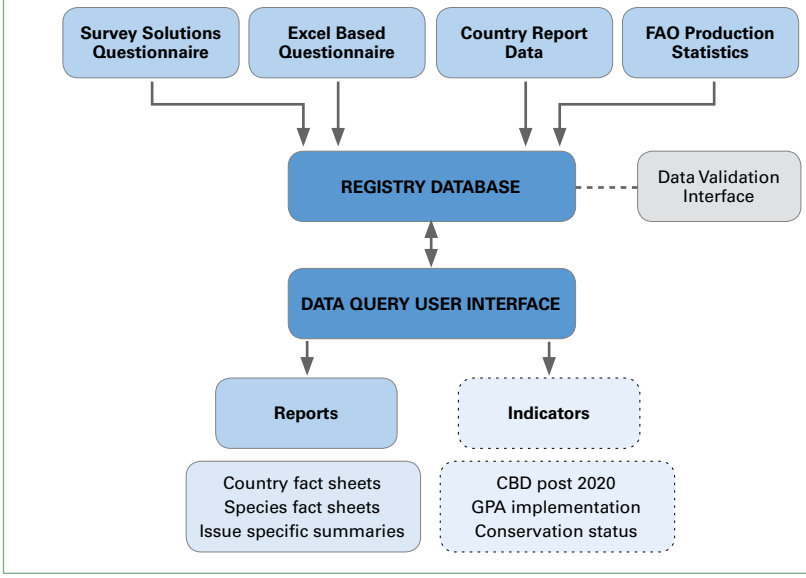


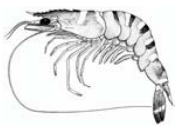
Written by:
Graham Mair
Daniela Lucente
Kiran Viparthi
Anton Ellenbroek
FAO Fisheries and Aquaculture Division, Rome, Italy

1. https://unstats.un.org/sdgs/metadata?Text=&Goal=2&Target=2.5
2. For example, WIEWS (**www.fao.org/wiews/en**), DAD-IS (**www.fao.org/dad-is/en**)

sources for all species and farmed types. The questionnaire for the prototype is developed based on the World Bank's Survey Solutions platform,[3] but offline data entry for most fields is also possible via an Excel spreadsheet. This principal data source is supplemented by data on production extracted from FAO's FishStatJ data sets[4] and country report data collected during the preparation of the global assessment. These data combined are referred to as the Registry. Questionnaire data can be reviewed by FAO and validated by national focal points through a data validation interface. Validated data in the Registry can then be accessed by stakeholders through a data-query user interface.

FIGURE 1 – Structure of AquaGRIS. The prototype already has the capability to generate reports. The capacity to generate a range of indicators will be available in the full version





The interface of the AquaGRIS prototype enables data from the Registry to be filtered using a range of parameters and enabling the generation of information reports in the form of country or species fact sheets. Specific reports can also be generated summarizing information relating to: (i) characterization, inventory and monitoring; (ii) conservation and sustainable use; (iii) development of species and farmed types; and (iv) policies, institutions and capacity.

Scope of data available in the prototype

The prototype enables users to conduct basic searches of the available data in the system and generate reports.[5] Data gathering for the prototype was done through species experts. Table 1 summarizes the information from the ten main species (representing a range of different taxa) for which genetic data are available in the prototype. The system is designed to contain data on the more than 600 species for which aquaculture has been reported to FAO. All FAO Member Nations will be enabled to submit their information. The prototype currently contains core data, including a total of 114 species covering 44 different countries and lists over 250 primary farmed types for these species in these countries. A full national data set is available for the Philippines, which participated in a trial exercise to collect national data on all species and farmed types; other countries are being sought for similar trials. It should be noted that the data in the prototype, while representing real data, were entered primarily to test and validate the information system and have not yet been verified by national focal points (NFPs); therefore, the data should not be published in any form.

3. https://thedocs.worldbank.org/en/doc/186231611660731709-0050022021/original/overview.pdf
4. www.fao.org/fishery/statistics/software/fishstatj/en
5. www.fao.org/aquatic-genetic-resources/activities/aquagris/en/

Benefits to Members

An expert workshop held in 2019 reviewed potential stakeholders in a global information system and highlighted five principal stakeholders having most to benefit from the information system from among 16 different categories of stakeholders identified. Table 2 summarizes the potential value of the

TABLE 1 – Species for which data have already been entered into the Registry in the prototype phase

Species	Scope of data entered to date
Artemia franciscana	Brazil, China, Ecuador, Kenya, Malaysia, India, Iran (Islamic Republic of), Thailand, Viet Nam
Magallana gigas (formerly *Crassostrea gigas*)	Canada, United States of America
Penaeus vannamei	China, India, Indonesia, Malaysia, Philippines, Thailand, United States of America, Viet Nam
Chanos chanos	Malaysia, Philippines, United Republic of Tanzania
Cyprinus carpio	Belarus, Czechia, Germany, Hungary, Poland, Russian Federation, Serbia, Ukraine
Colossoma macropomum	Brazil
Salmo salar	Australia, Canada, Chile, Faroe Islands, Iceland, Norway, United Kingdom of Great Britain and Northern Ireland
Eucheuma denticulatum	Indonesia, Kenya, Madagascar, Mozambique, Philippines
Kappaphycus alvarezii	Brazil, Cambodia, China, Cook Islands, Costa Rica, Ecuador, India, Indonesia, Kenya, Kiribati, Madagascar, Malaysia, Marshall Islands, Mozambique, Myanmar, Papua New Guinea, Philippines, Solomon Islands, Sri Lanka, United Republic of Tanzania, Venezuela (Bolivarian Republic of), Viet Nam
Kappaphycus striatus	China, Indonesia, Malaysia, Philippines, Viet Nam

categories of information available in AquaGRIS to these five principal stakeholders.

Some examples of applications of the information system for different stakeholders could include:

i) A tilapia farmer in the Philippines could access AquaGRIS to identify all farmed types of tilapia available in the country, understand the properties and characteristics of those farmed types, and find potential sources of specific farmed types that meet their particular needs.
ii) A policy-maker in Chile wanting to adapt policy based on terrestrial genetic diversity to incorporate aquatic diversity could produce a country report that would identify all aquatic genetic resources in the country and identify those resources contributing most to production and the potential risks associated with those species to inform policy development.
iii) An international conservation non-governmental organization could generate a species report on a particular species, identify the number of countries where that species is farmed as a native or non-native species, identify whether it represents a risk to the environment, and potentially identify (where reports exist) examples of impacts of that species and determine the production and value of that species in aquaculture.

TABLE 2 – Principal stakeholders in AquaGRIS and the potential value of the categories of information available in AquaGRIS to the stakeholder

Information in AquaGRIS	PRINCIPAL STAKEHOLDERS				
	Aquaculture producers (growers and hatcheries)	Policy-makers	State resource managers	Regional/ international organizations	Conservation managers
Performance characteristics and sources of available farmed types	✓ ✓ ✓	✓	✓ ✓	✓ ✓	✓
Production of species/ farmed types	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓
Census of aquatic genetic resources (AqGR) in aquaculture and wild relatives	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓
Risk status of species and farmed types	✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓
Impact status of species and farmed types	✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓
Lists of introduced and native species	✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓
Standard names and descriptions of AqGR	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓
Genetic technology usage	✓ ✓	✓ ✓	✓ ✓	✓	✓ ✓
Indicators of the status of AqGR	✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓

Note: Number of ticks represents the relative value of information to each respective stakeholder.

Next stages of development of AquaGRIS

Following recent confirmation of further funding from the Government of Germany, the next phase of development of AquaGRIS is underway with the objective of transforming the prototype into a fully functional system. The specific objectives are:

i) Develop an updated questionnaire incorporating feedback on the prototype and collection of additional data, including:
   a) data on wild relatives of species used in aquaculture; and
   b) data to support the development of indicators on AqGR status.
ii) Develop a new more user-friendly and flexible data entry tool;
iii) Expand the user query interface to enable access to all available Registry data.

FAO's principal points of contact for collecting data for AquaGRIS are the designated NFPs for Member Nations; the NFP is responsible for validating national data before the data are made available and searchable via the Registry database. In addition to the further development of the structure and functions of AquaGRIS outlined above, FAO is looking, over the next two years, to develop partnerships among experts, key organizations and institutions to work with NFPs to source and upload information on AqGR into AquaGRIS. We hope we can develop initiatives covering multiple countries and identify sources of data covering major aquaculture species in particular. While NFPs are responsible for national data uploaded and available through AquaGRIS, FAO can assist experts and organizations to work with NFPs to populate the system. The authors thus encourage country representatives (including NFPs) and experts with specific relevant knowledge to contact us (AquaGRIS@fao.org) to discuss opportunities for data entry.

SEE ALSO

Mair, G.C. and Lucente, D. 2020. What are "Farmed Types" in aquaculture and why do they matter? *FAO Aquaculture News*, 61: 40–42. **www.fao.org/3/ca8302en/CA8302EN.pdf#page=40**

Moving Forward on Restorative Aquaculture to Benefit Nature and People

Restorative aquaculture occurs when commercial or subsistence aquaculture provides direct ecological benefits to the environment, with the potential to generate net positive environmental outcomes. These positive outcomes can include provision of habitat for other species, improvement of water quality, and climate change mitigation and adaptation. Based on this definition, a recently published white paper entitled ***Global Principles of Restorative Aquaculture*** has put forward a set of principles to provide guidance and establish parameters around the implementation of this practice, and forge a common understanding of nature-positive aquaculture as an important food production and restoration solution. The white paper draws on a range of case studies to shape this guidance and provides road maps to assist industry and government.

The work was the joint effort of an expert working group led by The Nature Conservancy and comprised of multidisciplinary scientists from 12 highly regarded institutions, including FAO, the World Bank and WorldFish. FAO has been devoting increasing effort to promoting restorative aquaculture, including an agenda on aquatic plants in the 11th Session of the Sub-Committee on Aquaculture, which is expected to be held in Mexico in the first half of 2022, and the recent publication ***Seaweeds and Microalgae: An Overview for Unlocking Their Potential in Global Aquaculture Development***.

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Cultivation of *Kappaphycus alvarezii* in the Philippines (left). Production of spirulina in Chad (upper right). Wild collection of *Ascophyllum nodosum* in Canada (lower right)

Written by:

Heidi Alleway

The Nature Conservancy

Junning Cai

FAO Fisheries and Aquaculture Division, Rome, Italy

Classification of Fisheries and Aquaculture Products: The Harmonized System

Fisheries and aquaculture products are important international commodities. In 2019, 36 percent of total fisheries and aquaculture products were traded internationally, reaching USD 162 billion. This amount represents a 2.1 percent decrease on the record high reached in 2018. A total of 221 countries and territories reported fish and fishery trading activity, exposing about 78 percent of fisheries and aquaculture products to competition from international trade.

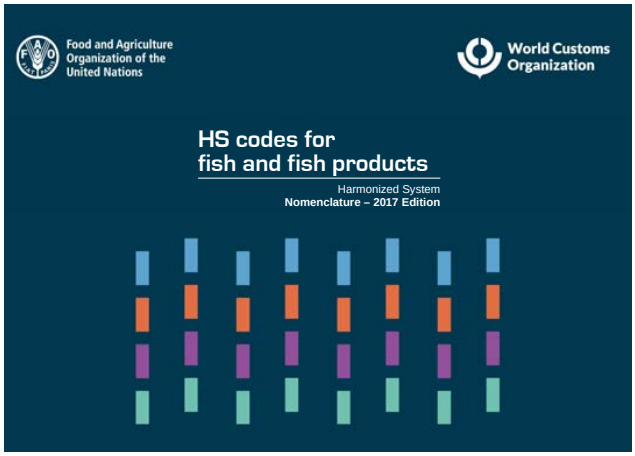
Information sharing is essential to enhancing market access for traditional players and new entrants. The availability of reliable and accurate information about markets and trade is critical to allow fair appropriation of the benefits of international trade to countries and the industry.

In this regard, FAO GLOBEFISH,[1] in cooperation with the World Customs Organization (WCO), developed the publication *HS Codes for Fish and Fish Products* (GLOBEFISH HS Handbook) to facilitate the classification of fisheries and aquaculture products in international trade by enhancing the understanding of the Harmonized System.

The Harmonized System (HS) is an international standard nomenclature to allow traded goods to be classified on a common basis for customs purposes. It comprises approximately 5 300 product descriptions arranged in 99 chapters, grouped in 21 sections. It is possible to classify all physical goods using the HS standard six-digit code system. All exported and imported products are classified using a national classification system based on the HS. Countries use the basis of the HS code in their national classification with the possibility of creating additional digits for specific purposes. The HS is also used for statistical, taxation, control and monitoring purposes at the country level. It has a wide range of users, including governments, industry, international organizations, academia and market analysts.

In addition, HS facilitates countries to implement national control of specific products covered by international conventions or agreements, such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which includes fisheries and aquaculture products.

Written by:
Marcio Castro de Souza
Mariana Toussaint
FAO Fisheries and Aquaculture Division, Rome, Italy



Fisheries and aquaculture products usually have long value chains, where a given fish may be harvested in one country, processed in another and consumed in yet another. Therefore, proper classification of fisheries and aquaculture products facilitates having smooth international transactions and obtaining preferential access, if existent.

The classification of fisheries and aquaculture products using the HS is complex. Fisheries and aquaculture products have various species and treatments, creating complex layers covering different products. For example, Pacific salmon is classified based on its form or treatment, such as live, fresh, chilled, frozen, salted, dried, in brine, and prepared or preserved, among others.

On many occasions, when analyzing international trade information (tariffs or trade data flows), products can be associated with hard-to-understand descriptions. The GLOBEFISH HS Handbook presents all possible classifications of fisheries and aquaculture products by species, with a complete description of each HS code in a practical and easy-to-read way.

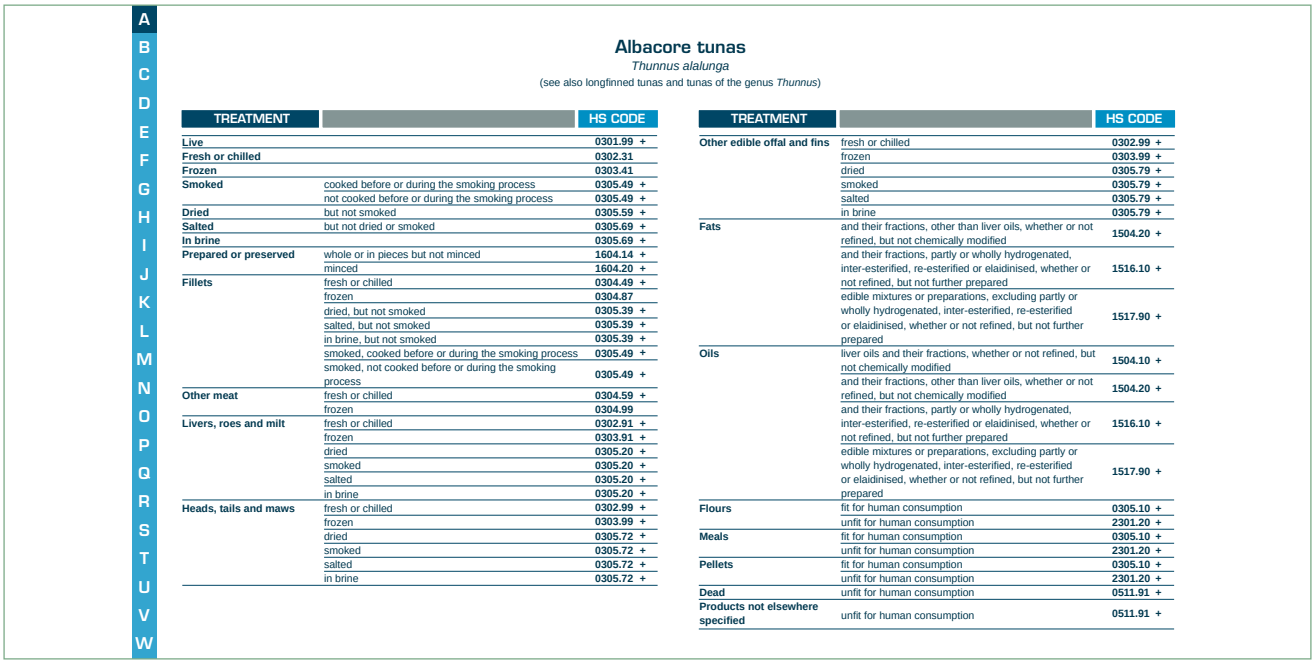
For example, frozen vannamei shrimp (*Litopenaeus vannamei*) is classified under HS code 0306.17 with the following description in the WCO HS and the GLOBEFISH HS Handbook:

The GLOBEFISH HS Handbook allows understanding precisely to what products the code refers. A self-contained description of each HS code is presented in the second section of the publication, where all HS codes for fisheries and aquaculture products are listed in the order they appear in the HS. This detailed description avoids using generic terms, such as "other", including all possible exceptions for each code. This publication section is instrumental to search by HS code.

In the first section of the publication, all species in the HS are presented by their common name, listing all possible classifications of their products and treatments and the

1. FAO GLOBEFISH, a multi-donor funded project established in 1984 in the Fisheries and Aquaculture Division of FAO, aims to bridge the information gap and reduce asymmetries by providing up-to-date information on markets and trade on a wide scale in a simple language with the continuous introduction of new products. If you want to be informed periodically about news on trade and markets of fisheries and aquaculture products by GLOBEFISH, please register at https://bit.ly/GLOBEFISHUSER

HS code description	Other shrimps and prawns, frozen
GLOBEFISH HS Handbook description	Shrimps and prawns, frozen, whether in shell or not; excluding cold-water shrimps and prawns Shrimps and prawns, in shell, cooked by steaming or by boiling in water, frozen; excluding cold-water shrimps and prawns



A B C D E F G H I J K L M N O P Q R S T U V W

Albacore tunas

Thunnus alalunga

(see also longfinned tunas and tunas of the genus *Thunnus*)

TREATMENT		HS CODE
Live		0301.99 +
Fresh or chilled		0302.31
Frozen		0303.41
Smoked	cooked before or during the smoking process	0305.49 +
	not cooked before or during the smoking process	0305.49 +
Dried	but not smoked	0305.59 +
Salted	but not dried or smoked	0305.69 +
In brine		0305.69 +
Prepared or preserved	whole or in pieces but not minced	1604.14 +
	minced	1604.20 +
Fillets	fresh or chilled	0304.49 +
	frozen	0304.87
	dried, but not smoked	0305.39 +
	salted, but not smoked	0305.39 +
	in brine, but not smoked	0305.39 +
	smoked, cooked before or during the smoking process	0305.49 +
	smoked, not cooked before or during the smoking process	0305.49 +
Other meat	fresh or chilled	0304.59 +
	frozen	0304.99
Livers, roes and milt	fresh or chilled	0302.91 +
	frozen	0303.91 +
	dried	0305.20 +
	smoked	0305.20 +
	salted	0305.20 +
	in brine	0305.20 +
Heads, tails and maws	fresh or chilled	0302.99 +
	frozen	0303.99 +
	dried	0305.72 +
	smoked	0305.72 +
	salted	0305.72 +
	in brine	0305.72 +

TREATMENT		HS CODE
Other edible offal and fins	fresh or chilled	0302.99 +
	frozen	0303.99 +
	dried	0305.79 +
	smoked	0305.79 +
	salted	0305.79 +
	in brine	0305.79 +
Fats	and their fractions, other than liver oils, whether or not refined, but not chemically modified	1504.20 +
	and their fractions, partly or wholly hydrogenated, inter-esterified, re-esterified or elaidinised, whether or not refined, but not further prepared	1516.10 +
	edible mixtures or preparations, excluding partly or wholly hydrogenated, inter-esterified, re-esterified or elaidinised, whether or not refined, but not further prepared	1517.90 +
Oils	liver oils and their fractions, whether or not refined, but not chemically modified	1504.10 +
	and their fractions, other than liver oils, whether or not refined, but not chemically modified	1504.20 +
	and their fractions, partly or wholly hydrogenated, inter-esterified, re-esterified or elaidinised, whether or not refined, but not further prepared	1516.10 +
	edible mixtures or preparations, excluding partly or wholly hydrogenated, inter-esterified, re-esterified or elaidinised, whether or not refined, but not further prepared	1517.90 +
Flours	fit for human consumption	0305.10 +
	unfit for human consumption	2301.20 +
Meals	fit for human consumption	0305.10 +
	unfit for human consumption	2301.20 +
Pellets	fit for human consumption	0305.10 +
	unfit for human consumption	2301.20 +
Dead	unfit for human consumption	0511.91 +
Products not elsewhere specified	unfit for human consumption	0511.91 +

0301.11 - 0302.41

Full description of fish and fish products

0301.11	Ornamental freshwater fish, live
0301.19	Ornamental fish, live; excluding freshwater fish
0301.91	Trout *(Salmo trutta, Oncorhynchus mykiss, Oncorhynchus clarki, Oncorhynchus aguabonita, Oncorhynchus gilae, Oncorhynchus apache* and *Oncorhynchus chrysogaster)*, live
0301.92	Eels *(Anguilla spp.)*, live
0301.93	Carp *(Cyprinus spp., Carassius spp., Ctenopharyngodon idellus, Hypophthalmichthys spp., Cirrhinus spp., Mylopharyngodon piceus, Catla catla, Labeo spp., Osteochilus hasselti, Leptobarbus hoeveni, Megalobrama spp.)*, live
0301.94	Atlantic and Pacific bluefin tunas *(Thunnus thynnus, Thunnus orientalis)*, live
0301.95	Southern bluefin tunas *(Thunnus maccoyii)*, live
0301.99	Fish, live; excluding Atlantic bluefin tunas, carp, eels, Pacific bluefin tunas, Southern bluefin tunas and trout
0302.11	Trout *(Salmo trutta, Oncorhynchus mykiss, Oncorhynchus clarki, Oncorhynchus aguabonita, Oncorhynchus gilae, Oncorhynchus apache* and *Oncorhynchus chrysogaster)*, fresh or chilled; excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.13	Pacific salmon *(Oncorhynchus nerka, Oncorhynchus gorbuscha, Oncorhynchus keta, Oncorhynchus tschawytscha, Oncorhynchus kisutch, Oncorhynchus masou* and *Oncorhynchus rhodurus)*, fresh or chilled; excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.14	Atlantic salmon *(Salmo salar)*, fresh or chilled; excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.19	Salmonidae, fresh or chilled; excluding trout, Atlantic salmon, Danube salmon and Pacific salmon, and also excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.21	Halibut *(Reinhardtius hippoglossoides, Hippoglossus hippoglossus, Hippoglossus stenolepis)*, fresh or chilled; excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.22	Plaice *(Pleuronectes platessa)*, fresh or chilled; excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.23	Sole *(Solea spp.)*, fresh or chilled; excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.24	Turbots *(Psetta maxima)*, fresh or chilled; excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.29	Flat fish *(Pleuronectidae, Bothidae, Cynoglossidae, Soleidae, Halibut, Scophthalmidae* and *Citharidae)*, fresh or chilled; excluding halibut, plaice, sole and turbots, and also excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.31	Albacore tunas or longfinned tunas *(Thunnus alalunga)*, fresh or chilled; excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.32	Yellowfin tunas (*Thunnus albacares*), fresh or chilled; excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.33	Skipjack or stripe-bellied bonito (*Euthynnus (Katsuwonus) pelamis*), fresh or chilled; excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.34	Bigeye tunas (*Thunnus obesus*), fresh or chilled; excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.35	Atlantic and Pacific bluefin tunas (*Thunnus thynnus, Thunnus orientalis*), fresh or chilled; excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.36	Southern bluefin tunas (*Thunnus maccoyii*), fresh or chilled; excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.39	Tunas (of the genus *Thunnus*), fresh or chilled; excluding albacore or longfinned tunas, Atlantic bluefin tunas, bigePacific bluefin tunas, skipjack or stripe-bellied bonito, southern bluefin tunas and yellowfin tunas, and also excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal
0302.41	Herrings (*Clupea harengus, Clupea pallasii*), fresh or chilled; excluding fillets and other meat (whether or not minced), livers, roes, milt, fins, heads, tails, maws and other edible offal

respective HS codes. The species are listed alphabetically and divided based on their taxonomic group (fish, crustaceans, molluscs or other aquatic invertebrates).

The GLOBEFISH HS Handbook is a practical and auxiliary tool to facilitate classification and enhance the understanding of the HS from the angle of fisheries and aquaculture products without any modification of its structure nor the species grouping.

With this publication, FAO GLOBEFISH contributes to disseminating the HS Handbook managed by the WCO to better understand fisheries and aquaculture product classification. The GLOBEFISH HS Handbook is available and downloadable at **ISSU**. There is also a video message of the launching of the publication with a comprehensive explanation of the HS classification system of products.

SEE ALSO

FAO & WCO. 2021. *HS codes for fish and fish products: harmonized system. Nomenclature – 2017 edition.* Rome. **https://doi.org/10.4060/cb3813en**

FAO & WCO. 2021. *HS codes for fish and fish products: harmonized system. Nomenclature – 2017 edition.* Video message is available at **https://www.youtube.com/watch?v=vJsUw7NGESA&feature=emb_imp_woyt**

Colleagues in Motion

©FAO/G. Robinson (photo taken before the COVID-19 pandemic)

Ruth Garcia Gomez

Aquaculture Expert

Global & Regional Processes Team for Sustainable Aquaculture

Ruth Garcia Gomez is currently working as a consultant for NFIAP Team as aquaculture specialist. Previously to joining FAO she was based in the Pacific Region, working for the Cawthron Aquaculture Institute and Aquaculture New Zealand, based in New Zealand during 2020-2021, and for the Secretariat of Pacific Community (SPC) as Aquaculture and Aquatic Biosecurity Specialist between 2010-2020. At the SPC her role was to provide technical assistance in the field of aquaculture, aquatic health management and aquatic biosecurity to the 22 Member countries and territories of the Pacific region (e.g., Cook Islands, Tonga, Samoa, Fiji, Papua New Guinea, Vanuatu, among others). Before joining the SPC, Ruth Garcia Gomez worked as Aquaculture Officer within the Aquaculture Branch of the FAO Department of Fisheries and Aquaculture. She graduated in Veterinary Science-Animal Husbandry from the Complutense University of Madrid, Spain, with a specialisation in Aquaculture Science and completed her PhD in the Veterinary Science Branch-Aquatic Animal Health Department at the same University. Ruth Garcia Gomez obtained a master's degree in international development strategies, agents and policies from the Basque Country University of HEGOA, in 2006.

Since 2001, Ruth Garcia Gomez has worked in Africa (Democratic Republic of Congo and Uganda), Asia (Cambodia and Viet Nam), the Maghreb (Egypt and Morocco), Latin America (Ecuador and Colombia) and Europe (France and Spain), in the fields of aquaculture, aquatic animal health, aquatic biosecurity and aquatic genetic resources management, both in cooperation for development and research projects.

Samia Sarkis

Aquaculture Expert

Global & Regional Processes Team for Sustainable Aquaculture

Samia Sarkis of multi-cultural background (French and Middle Eastern), a marine biologist, educated in Canada, the United Kingdom, and France. She received her Ph.D. in 1992 from the University of Plymouth (U.K.). Samia specialized in aquaculture and focused on R&D of molluscan species for sustainable production, which she applied to develop a pilot scale modular hatchery for subtropical scallop species and improve large scale commercial seed production in Northern temperate areas. She worked in Europe, North and South America, and in the Wider Caribbean Region. Samia first worked for FAO as a consultant in 2003, and shared her knowledge in a technical hatchery guide for bivalve species; she subsequently became activity coordinator for FAO's assessment of the feasibility of a Regional Hatchery for the Wider Caribbean. Expanding her scope of work, she linked science to policy as Protected Species Coordinator for the Bermuda Government, moving on as UK Overseas Territories Officer for the Joint Nature Conservation Committee (JNCC, UK). Samia was elected Director of the Latin American and Caribbean Chapter (World Aquaculture Society) and appointed Chair of the Student Committee between 2014-2016. Having worked in research institutes, commercial operations, and government agencies, she brings technical expertise in lower trophic aquaculture from pilot to large scale, as well as experience in provision of tools for improved policy and decision-making. She has written and co-authored peer-reviewed scientific publications on aquaculture-related research and environmental economics, prepared Cabinet Papers for improved policy, contributed to the development of strategies for aquaculture in the Wider Caribbean Region, and more recently to the integration of aquaculture in Marine Spatial Planning.

Doriane Marin

Legal Expert/Consultant

Global & Regional Processes Team for Sustainable Aquaculture

Coming from the French Mediterranean regions of Corsica and Provence, Doriane has a Master Degree in international law and administration from La Sorbonne. From 2019-2020 she worked in Myanmar for the FAO Fish Adapt project where she focused on mainstreaming the ecosystem approach to fisheries management and climate change adaptation into the national regulatory framework. During the COVID-19 pandemic, she returned to Europe to work for European Commission before joining the FAO Fisheries and Aquaculture Division as a Legal Expert from May to October 2021. She supported the drafting of a retrospective report on the past declarations adopted during the previous Global Conferences on Aquaculture, specifically the Bangkok Declaration and Phuket Consensus. She also contributed to the elaboration of the Shanghai Declaration for Sustainable Food and Agriculture. Doriane now works for DG MARE in the European Commission.

Publications

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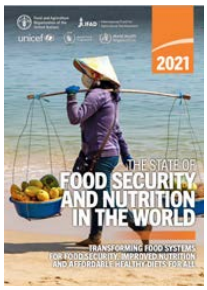
Flagship Publications



FAO 2021

Transforming food systems for food security, improved nutrition and affordable healthy diets for all – *Rome*

In recent years, several major drivers have put the world off track to ending world hunger and malnutrition in all its forms by 2030. The challenges have grown with the COVID-19 pandemic and related containment measures. This report presents the first global assessment of food insecurity and malnutrition for 2020 and offers some indication of what hunger might look like by 2030 in a scenario further complicated by the enduring effects of the COVID-19 pandemic. It also includes new estimates of the cost and affordability of healthy diets, which provide an important link between the food security and nutrition indicators and the analysis of their trends. Altogether, the report highlights the need for a deeper reflection on how to better address the global food security and nutrition situation.

To understand how hunger and malnutrition have reached these critical levels, this report draws on the analyses of the past four editions, which have produced a vast, evidence-based body of knowledge of the major drivers behind the recent changes in food security and nutrition. These drivers, which are increasing in frequency and intensity, include conflicts, climate variability and extremes, and economic slowdowns and downturns – all exacerbated by the underlying causes of poverty and very high and persistent levels of inequality. In addition, millions of people around the world suffer from food insecurity and different forms of malnutrition because they cannot afford the cost of healthy diets. From a synthesized understanding of this knowledge, updates and additional analyses are generated to create a holistic view of the combined effects of these drivers, both on each other and on food systems, and how they negatively affect food security and nutrition around the world.

In turn, the evidence informs an in-depth look at how to move from silo solutions to integrated food systems solutions. In this regard, the report proposes transformative pathways that specifically address the challenges posed by the major drivers, also highlighting the types of policy and investment portfolios required to transform food systems for food security, improved nutrition, and affordable healthy diets for all. The report observes that, while the pandemic has caused major setbacks, there is much to be learned from the vulnerabilities and inequalities it has laid bare. If taken to heart, these new insights and wisdom can help get the world back on track towards the goal of ending hunger, food insecurity, and malnutrition in all its forms.

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COVID-19 Policy briefs and resources

FAO 2021

Conséquences de la covid-19 sur la pêche et l'aquaculture en Asie – *Bangkok*

Le 10 avril 2020, un mois après la déclaration de pandémie de covid-19 par l'Organisation mondiale de la Santé, la FAO a publié un document sur les Effets de la covid-19 sur les systèmes alimentaires halieutiques et aquacoles (FAO, 2020a). Ce document d'orientation, de portée mondiale, abordait plus particulièrement la situation dans certains pays d'Asie. Le présent document fournit des informations actualisées, notamment de nouvelles données, des faits récents et des observations. Au moment de sa rédaction, la pandémie battait son plein et ne semblait pas sur le point de fléchir.

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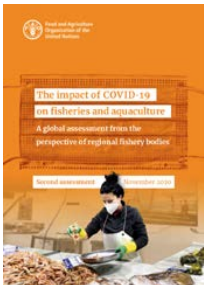

FAO 2021

The impact of COVID-19 on fisheries and aquaculture - A global assessment from the perspective of regional fishery bodies – *Rome*

This assessment, undertaken in November 2020, is a follow-up to the initial assessment undertaken in April 2020, and used the same methodology. This present paper provides a summary of responses to questionnaires circulated to regional fisheries management organizations (RFMOs) and regional fisheries advisory bodies (RFABs) to determine the impacts of restrictions imposed by COVID-19, upon the management, production and supply of fisheries products from capture fisheries and aquaculture. Comparisons are made between the responses given in April 2020 in the early phase of the pandemic, and those given in November 2020, some seven months later. The objective is to provide a global overview of the impacts of COVID-19 from the perspective of the secretariats of regional fisheries management organizations (RFMOs) and regional fisheries advisory bodies (RFABs), and collate examples of good practices and suggestions to guide development of mitigation measures.

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Technical Papers

FAO 2021

Chinese title: 小型鱼菜共生食物生产 - 鱼菜综合种养技术
English title: **Small-scale aquaponic food production - Integrated fish and plant farming** – *Rome*

This paper was first published by FAO in English and Arabic. The key objective is the sustainable use of resources for the production of food (vegetables and fish). This technical paper discusses the three groups of living organisms (bacteria, plants and fish) that make up the aquaponic ecosystem. It presents management strategies and troubleshooting practices, as well as related topics, specifically highlighting the advantages and disadvantages of this method of food production. This publication discusses the main theoretical concepts of aquaponics, including the nitrogen cycle, the role of bacteria, and the concept of balancing an aquaponic unit. It considers water quality, testing and sourcing for aquaponics, as well as methods and theories of unit design, including the three main methods of aquaponic systems: media beds, nutrient film technique, and deep water culture. The publication includes other key topics: ideal conditions for common plants grown in aquaponics; chemical and biological controls of common pests and diseases including a compatible planting guide; common fish diseases and related symptoms, causes and remedies; tools to calculate the ammonia produced and biofiltration media required for a certain amount of fish feed; production of homemade fish food; guidelines and considerations for establishing aquaponic units; a cost–benefit analysis of a small-scale, media bed aquaponic unit; a comprehensive guide to building small-scale versions of each of the three aquaponic methods; and a brief summary of this publication designed as a supplemental handout for outreach, extension and education.

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Workshop Reports

FAO 2021

Report of the FAO Vigo Dialogue on social responsibility in the fisheries and aquaculture value chains – Addressing current problems triggered by COVID-19 – *Rome*

The 2020 FAO Vigo Dialogue focused on promoting human and labour rights to ensure better social practices along fisheries and aquaculture value chains, including emphasizing social problems associated with the COVID-19 pandemic. The main issues and challenges that the sector is facing were discussed and identified. The Dialogue raised awareness of the situation faced by fish workers and the industry due to the pandemic, and allowed FAO to collaborate with relevant stakeholders by providing a clear outline of the significant challenges on social issues in fisheries and aquaculture value chains.

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FAO 2021

Informe de la Reunión Regional de la FAO sobre el Uso de Antimicrobianos en la Acuicultura en América Latina – Santiago

La resistencia antimicrobiana (RAM) es una amenaza mundial y la disponibilidad y el uso prudente de antimicrobianos en organismos terrestres y acuáticos y la producción de cultivos agrícolas son fundamentales para la salud y la productividad de éstos. En el marco del proyecto regional de la FAO "Apoyo al desarrollo de planes nacionales de acción sobre la resistencia a los antimicrobianos en América Latina y el Caribe" (FMM/RLA/215/MUL), se organizó en Lima, Perú, los dias 22 al 24 noviembre 2017 la "Reunión Regional de Expertos de la FAO sobre el Uso de Antimicrobianos en la Acuicultura en América Latina: Desafíos y Perspectivas Futuras".Uno de los objetivos de la reunión fue la sensibilización de las autoridades y otros actores sobre la importancia de la propagación de RAM a través del medio acuícola y los insumos para la acuicultura. Participaron delegados de ocho países productores acuícolas en América Latina (Argentina, Brasil, Chile, Costa Rica, Ecuador, Honduras, México y Perú) y expertos seleccionados e invitados para compartir experiencias y participación en las discusiones generales. Además, participaron representantes de empresas productoras de salmón, camarón y tilapia, y un representante de la industria productora de alimentos. Durante las sesiones se presentaron las opiniones de los respectivos gobiernos y la industria sobre las acciones actuales o futuras para el control en el uso de antimicrobianos en la acuicultura. La reunión finalizó con una jornada de trabajo donde los países elaboraron una matriz regional con elementos centrales para la contención de la RAM.

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FAO 2021

Report of the Regional Workshop for the Near East on the Development of a Registry of Farmed Types of Aquatic Genetic Resources (Incorporating a review of strategic priorities for a Global Plan of Action), Virtual Workshop, 7–8 December 2020 – *Rome*

This report summarizes the proceedings and outcomes of the Regional Workshop for the Near East on the "Development of a Global Information System of Farmed Types of Aquatic Genetic Resources (Incorporating a review of strategic priorities for a Global Plan of Action)" held from 7 to 8 December 2020. The objectives of the workshop were to promote standardized use of nomenclature and terminology in the description and categorization of aquatic genetic resources (AqGR), especially below the level of species (i.e. farmed types), to identify priority regional stakeholders who would benefit from and could contribute to an information system, such as the Registry, to evaluate the key elements of the prototype Registry using regionally relevant species and their farmed types, and to review the strategic priorities and propose concrete activities under each of the four Priority Areas of the GPA. The workshop sessions were attended by National Focal Points for Aquatic Genetic Resources from the Near East, officials from ministries and research institutions. Participants identified government resource managers, academia and researchers as the principal stakeholders and beneficiaries of the Registry.

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FAO 2021

Regional Consultative Workshop Strengthening Aquaculture Governance for Sustainable Development in Asia-Pacific – *Bangkok*

Aiming to build regional capacity in aquaculture governance in Asia-Pacific, FAO and NACA jointly implemented a regional consultation in collaboration with NACA member governments to assess the status of aquaculture governance in Asia, share experiences and lessons learned in aquaculture governance among countries, and recommend strategies and actions for further improvement. The consultation consisted of two major activities: country assessment studies and a regional consultative workshop. The country assessment studies were carried out by seven national experts in seven selected countries including Cambodia, China, India, Indonesia, Malaysia, Thailand, and Viet Nam. The consultative workshop was conducted in 5-6 November 2019 in Bangkok, attended by 33 participants including experts and government officers from 15 Asian countries and representatives from FAO, NACA and the Asian Institute of Technology. The findings of the assessment studies were presented to the workshop, and participants then worked on identifying gaps, constraints, and challenges in aquaculture governance in the region and put forward recommendations for further improvement. This publication presents the seven country assessment studies and the outputs of the workshop, including the summary of the status of aquaculture governance in the region, challenges and issues in governing process, and recommendations for further strengthening aquaculture governance in the region.

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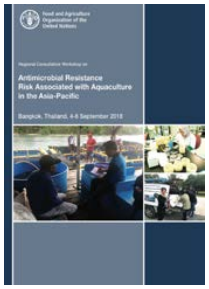

FAO 2021

Regional Consultative Workshop on Antimicrobial Resistance Risk Associated with Aquaculture in the Asia-Pacific– *Bangkok*

Aquaculture sector in Asia-Pacific has grown rapidly during the past four decades and contributed significantly to food security, nutrition, livelihood and overall socioeconomic development in the region. Meanwhile, disease problem has become increasingly challenging in aquaculture. Un-prudent and poorly controlled use of anti-microbial in animal disease control in aquaculture can have significant contribution to AMR risk. Although the control over the use of antimicrobial in aquaculture through some regulatory frameworks has been strengthened over the past decade in the region, it is far from adequate and effective in many Asian countries. In order to support the members to effectively address AMR in aquaculture for public health and sustainability of the sector, FAO and Network of Aquaculture Centres in Asia-Pacific (NACA) jointly organized the regional consultation on AMR associated with aquaculture in Asia-Pacific on 4-6 September 2018. This publication documents the conduct of the regional consultation and its outputs, which identified major issues and gaps in tackling AMR issue in aquaculture and recommended desirable interventions and long-term strategy to effective mitigate AMR risk related to aquaculture in the region.

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FAO 2021

Report of the Eighth Meeting of Regional Fishery Body Secretariats' Network. Rome, 24 February and 25 February 2021 - Virtual meeting – *Rome*

Thirty-one regional fishery bodies (RFBs) participated in the Eighth Meeting of the Regional Fishery Body Secretariats' Network (RSN-8). The meeting brought together RFBs with diverse mandates from all geographic regions, including FAO and non-FAO regional fishery bodies, marine and inland fishery advisory and management bodies, the UNDOALOS and other invited organizations. The meeting allowed participants to exchange views and discuss both global fisheries management and development issues in aquaculture, as these related to regional and global processes of particular relevance to RFBs. In addition, RSN-8 provided the opportunity to discuss the development and strengthening of the RSN, as well as a space for reflection on the outcomes of COFI 34 and their implications for regional fishery bodies. The meeting had a high level of participation, which underlined the role of the network as a unique forum in which to foster cooperation, facilitate discussion and share experiences.

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FAO 2021

General Fisheries Commission for the Mediterranean: Report of the webinar on the experience of the aquaculture sector through best practices and mitigation measures facing the COVID-19 crisis, 1 July 2020 – *Rome*

This report presents the outcomes of the webinar on "the experience of the aquaculture sector through best practices and mitigation measures facing the COVID-19 crisis" which took place on 1 July 2020. It was organized by the General Fisheries Commission for the Mediterranean (GFCM) of the Food and Agriculture Organization of the United Nations (FAO) in cooperation with the Regional Commission for Fisheries (RECOFI). The webinar aimed to address the pandemic's effects on aquaculture production as well as on supply chains, demand, local markets and trade, and to identify best practices and mitigation measures adopted by aquaculture farmers and countries. During the first thematic session, the experts highlighted the difficulties the aquaculture sector faced due to the effects of the COVID-19 pandemic. Furthermore, several mitigation approaches were pointed out: i) specific financial support programmes designed through the European Maritime and Fisheries Fund (EMFF); ii) a strong national aquaculture strategy guaranteeing self-sufficiency along the entire supply chain of shrimp farming in Saudi Arabia; iii) the issuing of subsidies and credit loans in a timely manner to help producers in Turkey; iv) the development of an online platform for fish auctioning to boost fisheries supply chain in Oman; v) companies opening direct communication channels between the government and the farms in the United Arab Emirates; and vi) solidarity between the sector and consumers, which allowed for the achievement of 50 percent of the programmed goals in the fish feed and larval industry in Tunisia. Other points addressed during the second thematic session included specific measures adopted and proposed, such as the focus on different aquaculture final products (e.g. frozen fish) and the establishment of local hatcheries and fish feed factories.

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FAO Circulars

FAO 2021

Recent advances in climate change vulnerability/risk assessments in the fisheries and aquaculture sector – *Rome*

Vulnerability and risk assessment is an important tool that has been used in the fisheries and aquaculture sector to assess the current and potential consequences of climate change in a variety of geographical, environmental and socio-economic contexts and scales. The resulting information on risks and vulnerabilities can then feed decision-making on adaptation, including allocation of resources and prioritization of areas for action. However, there is no harmonized approach nor methodology to conduct vulnerability and risk assessments. This publication seeks to analyze the different existing methodologies in order to contribute to laying the basis of a consistent approach to design future climate vulnerability and risk assessments in the fisheries and aquaculture sector. The publication builds on the findings outlined in the FAO Technical Papers No. 597 "Assessing climate change vulnerability in fisheries and aquaculture - Available methodologies and their relevance for the sector" and No. 627 "Impacts of climate change on fisheries and aquaculture - Synthesis of current knowledge, adaptation and mitigation options" and explores the recent advances in approaches of vulnerability and risk assessments, and the methodological developments to conduct such assessments.

The PDF can be accessed directly at:
www.fao.org/3/cb4585en/cb4585en.pdf

The document card can be found here:
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FAO 2021

Seaweeds and microalgae: an overview for unlocking their potential in global aquaculture development – *Rome*

Algae, including seaweeds and microalgae, contribute nearly 30 percent of world aquaculture production (measured in wet weight), primarily from seaweeds. Seaweeds and microalgae generate socio-economic benefits to tens of thousands of households, primarily in coastal communities, including numerous women empowered by seaweed cultivation. Various human health contributions, environmental benefits and ecosystem services of seaweeds and microalgae have drawn increasing attention to untapped potential of seaweed and microalgae cultivation. Highly imbalanced production and consumption across geographic regions implies a great potential in the development of seaweed and microalgae cultivation. Yet joint efforts of governments, the industry, the scientific community, international organizations, civil societies, and other stakeholders or experts are needed to realize the potential. This document examines the status and trends of global algae production with a focus on algae cultivation, recognizes the algae sector's existing and potential contributions and benefits, highlights a variety of constraints and challenges over the sector's sustainable development, and discusses lessons learned and way forward to unlock full potential in algae cultivation and FAO's roles in the process.

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FAO 2021

Guidelines for feed use in carp and trout production systems in Central Asia and Eastern Europe – *Ankara*

In aquaculture, the provision of high quality aquafeeds that satisfy the nutritional requirements of the culture species and optimize growth are a prerequisite to improving production yields, lowering production costs, and improving economic returns to farmers. Under semi-intensive and intensive carp and trout culture, aquafeed costs usually account for the highest single production cost, typically accounting for 50 – 60 percent of total production costs. The aquafeeds available to farmers vary widely with respect to quality, nutritional value and cost. Depending on the feed type, production system and farmer preferences, there are multiple feed management strategies that can be adopted by farmers. In order to optimise feed use and minimise feed production costs, it is essential that farmers select appropriate feeds and optimise their on farm feed management practices.

These guidelines are designed to provide farmers with practical guidance on how to select feeds and to optimise their use by implementing appropriate on-farm feed management practices. The guidelines provide an introduction to fish nutrition with a focus on the dietary nutritional requirements of commercially cultured carps and trout. The types of aquafeeds (live feeds, supplementary, farm-made and commercially manufactured feeds), their composition and nutritional value, manufacture and use are discussed. On-farm feed management practices focus on feeding methods, feed storage, and methods to optimise feed consumption (calculating feed rations, feeding frequency, assessing appetite and the feeding response).

The PDF can be accessed directly at:
www.fao.org/3/cb4640en/cb4640en.pdf

The document card can be found here:
www.fao.org/documents/card/en/c/cb4640en

Non-serial publications

FAO 2021

Top 10 species groups in global aquaculture 2019 – *Rome*

This factsheet presents the top 10 species groups in 2019 global aquaculture production and features seaweeds that are recently receiving increasing global attention as potential restorative aquaculture species. The ranking of all 68 species groups in global aquaculture 2019 is illustrated on the back cover. More information about the top 10 species groups at regional and national level can be found in a more comprehensive factsheet as supplementary materials. The comprehensive factsheet also elaborates on the species grouping methodology used in the ranking exercise.

The PDF can be accessed directly at:
www.fao.org/3/cb5186en/cb5186en.pdf

The document card can be found here:
www.fao.org/documents/card/en/c/cb5186en

FAO 2021

Manual para un sistema de monitoreo ambiental participativo para mejorar la capacidad de adaptación al cambio climático de las comunidades pesqueras y acuícolas en Chile – *Santiago*

El presente manual tiene como objetivo entregar las bases científicas y técnicas para diseñar e implementar un sistema de monitoreo ambiental participativo en caletas pesqueras de Chile, como herramienta para mejorar la adaptación al cambio climático. Este tipo de monitoreo se caracteriza por la participación activa de mujeres y hombres de la pesca y acuicultura que habitan y trabajan en las caletas, permitiendo incrementar su conocimiento sobre el ambiente costero local y contar con herramientas prácticas para observar los efectos del cambio climático. Para apoyar la capacitación de las personas que participarán en los monitoreos locales, el manual proporciona algunos conceptos claves del ecosistema costero chileno y sus procesos oceanográficos, así como algunas consecuencias del cambio climático sobre el mar y los recursos pesqueros. Asimismo, se expone la relevancia de los distintos tipos de monitoreos para obtener registros y observaciones que apoyen la toma de decisiones de mujeres y hombres de la pesca y acuicultura frente a los cambios que ya comienzan a percibir. Tras haber recogido las lecciones aprendidas de la experiencia piloto llevada a cabo en cuatro caletas de Chile: Riquelme (Tarapacá), Tongoy (Coquimbo), Coliumo (Biobío) y El Manzano (Los Lagos), en las que se diseño participativamente un monitoreo de variables ambientales asociadas al cambio climático, se proponen las etapas y metodologías para replicar estos programas de monitoreo en otras caletas de Chile. Finalmente, se formulan varias recomendaciones y sugerencias para desarrollar este tipo de programas en las caletas del país, así como propuestas de gobernanza para asegurar su sostenibilidad, como medida de disminución de la vulnerabilidad de las comunidades costeras frente a los efectos del cambio climático.

The PDF can be accessed directly at:
www.fao.org/3/cb3579es/cb3579es.pdf

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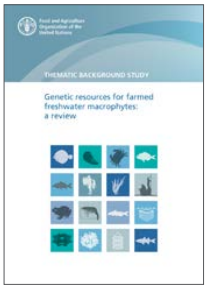

FAO 2021

Thematic Background Study - Genetic resources for farmed freshwater macrophytes: a review – *Rome*

At its Fifteenth Regular Session, the Commission on Genetic Resources for Food and Agriculture endorsed the preparation of a thematic study on the genetic resources of freshwater aquatic macrophytes (FAMs) of relevance for food and agriculture. This is an initiative in support of the preparation of the Report on The State of the World's Aquatic Genetic Resources for Food and Agriculture (http://www.fao.org/3/CA0454EN/ca0454en.pdf). The purpose of this study is to enhance the understanding of the relevance of FAMs for food security and human well-being. The cultivation of FAMs for food production, as well as for non-food uses, has long been unrecognized and underreported in most national and international agriculture and aquaculture statistics, including statistics regularly reported to the Food and Agriculture Organization of the United Nations (FAO) by Member Countries. However, it is well known that cultivated FAMs play a pivotal role in food security in many countries, especially in the developing countries of South and Southeast Asia.

The PDF can be accessed directly at:
www.fao.org/3/cb6597en/cb6597en.pdf

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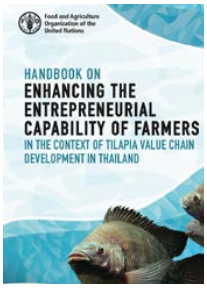

FAO 2021

Handbook on enhancing the entrepreneurial capability of farmers: In the context of tilapia value chain development in Thailand – *Bangkok*

This handbook aims to increase knowledge and understanding of value chain development, with farmed tilapia as an example. It describes the principles involved and explains the practical skills in analysing situations and designing an efficient business arrangement that would increase opportunities for business partners to participate in and effectively access the market. It is designed as a learning resource for training farmers and could be used by trainers, government officers, private entrepreneurs, community leaders, extension officers, researchers, and students. It has five chapters. Chapter I explains the principles and strategies of value chain development and the importance of their applications. Chapter II describes the main aspects of good aquaculture practices for tilapia farming in earthen ponds. Chapter III guides farmers' investment decisions on-farm operation, farm expansion, acquiring or upgrading farm assets, and how the investment can be financed. Chapter IV describes the processes and standards based on the guidelines prescribed for Thailand to ensure the safety and quality of fish products from culture to processing and marketing. Chapter V describes the concept and principles of developing a business plan, using that of a farmers' group to illustrate the plan.

The PDF can be accessed directly at:
www.fao.org/3/cb6099en/cb6099en.pdf

The document card can be found here:
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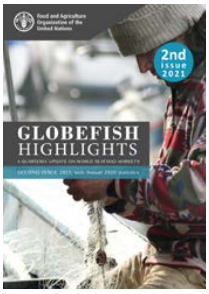

FAO 2021

GLOBEFISH Highlights - A quarterly update on world seafood markets – *Rome*

Since 1984, the FAO GLOBEFISH project (through a project unit established within the Fishery and Aquaculture Department of FAO www.fao.org/in-action/globefish) has been providing Governments, national and international stakeholders with relevant data, information and knowledge on fish trade in order to assist them in designing and implementing efficient and inclusive market and trade strategies. These strategies contribute to the sustainable development of the fish trade sector (including the economic, social and environmental aspects) and, at the same time, contribute to improving food and nutrition security and strengthening livelihood opportunities and are directly linked to SO4.

The publication contains a detailed quarterly update on market trends for a variety of major commodities. Combining the price information collected for the European Price Report with other market survey data collected by FAO GLOBEFISH, the report provides a detailed update on market trends for a variety of major commodities. Key market data is presented in a time series tabular or graphical form with a written analysis of trends and key events and news affecting commodities such as tuna, groundfish, small pelagics, shrimp, salmon, fishmeal and fish oil, cephalopods, bivalves and crustacea.

The PDF can be accessed directly at:
www.fao.org/3/cb6414en/cb6414en.pdf

The document card can be found here:
www.fao.org/documents/card/en/c/cb6414en

FAO 2021

Guidelines for aquaculture management in the Southern African Development Community, March 2019/ Lignes directrices pour la gestion de l'aquaculture dans la Communauté de développement de l'Afrique australe, Mars 2019/Directrizes para a gestão da aquacultura na Comunidade de Desenvolvimento da África Austral, Março de 2019. – *Rome*

This document presents the Guidelines for aquaculture management in the Southern African Development Community (SADC) – March 2020 that were approved by SADC member States in June 2019.

Ce document présente les Directives pour la gestion de l›aquaculture dans la Communauté de développement de l›Afrique australe (SADC) – mars 2020, qui ont été approuvées par les États membres de la SADC en juin 2019.

Este documento apresenta as Diretrizes para a gestão da aquicultura na Comunidade de Desenvolvimento da África Austral (SADC) – março de 2020, que foram aprovadas pelos estados membros da SADC em junho de 2019.

The PDF can be accessed directly at:
www.fao.org/3/cb4805t/cb4805t.pdf

The document card can be found here:
www.fao.org/documents/card/en/c/cb4805t

FAO 2021

Tackling child labour in fisheries and aquaculture – background paper – *Rome*

The global aquatic food industry, long under scrutiny over environmental sustainability concerns, has also come under increased scrutiny within the past decade over poor working conditions and severe human rights violations, including widespread use of forced labour and child labour. However, there is limited research and documentation available on child labour in fishing, aquaculture and fish and aquatic food processing globally. Much of the available evidence is centred on labour conditions in global supply chains. However, due to higher levels of informality, limited law enforcement capacity, and so on, it is more likely that children produce fish and aquatic-sourced foods for local consumption and domestic supply chains.

To realize SDG 14 and make fish and other aquatic-sourced food production truly sustainable food systems, it will be necessary to step up efforts to eliminate child labour, protect young workers against the worst forms of child labour (including hazardous work, forced labour, and child engagement in illegal activities) and invest in a healthy, well-educated workforce for the future.

This too is necessary to achieve SDG 8 and ensure that the millions of people who derive their living from fishing, aquaculture, and aquatic food processing work under decent conditions. This would entail expanding attention to aquatic food production for local and domestic markets in addition to the products that go into global supply chains.

This background paper presents the challenges, opportunities, and recommendations to tackle child labour in fisheries and aquaculture.

The document card can be found here:
www.fao.org/3/cb7159en/cb7159en.pdf

The document card can be found here:
www.fao.org/documents/card/en/c/cb7159en

FAO 2021

Seminario regional sobre estrategias de fomento del consumo de pescado con enfoque de salud y nutrición – *Santiago*

El presente documento contiene una síntesis de los principales elementos y estructura de los programas de fomento al consumo de pescados y mariscos que, con el objeto de mejorar la nutrición y la salud de la población, han impulsado los Gobiernos de la República Federativa de Brasil, la República de Honduras, Tamaulipas (en Los Estados Unidos Mexicanos), la República del Perú y la República Oriental del Uruguay; y que fueron presentados en el Seminario Regional sobre Estrategias de Fomento del Consumo de Pescado con Enfoque de Salud y Nutrición, celebrado de forma virtual el día 9 de noviembre de 2020, en el marco del Programa de Trabajo de la Comisión de Pesca en Pequeña Escala, Artesnal y Acuicultura de América Latina y el Caribe (COPPESAALC), con el ausipcio de la Oficina Subregional de la FAO para Mesoamérica.

The PDF can be accessed directly at:
www.fao.org/3/cb6305es/cb6305es.pdf

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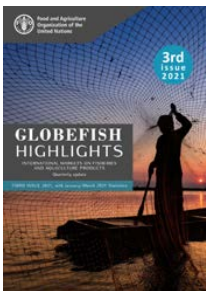

FAO 2021

GLOBEFISH Highlights – International Markets on Fisheries and Aquaculture Products - Quarterly Update – *Rome*

Since 1984, the FAO GLOBEFISH project (through a project unit established within the Fishery and Aquaculture Department of FAO www.fao.org/in-action/globefish) has been providing Governments, national and international stakeholders with relevant data, information and knowledge on fish trade in order to assist them in designing and implementing efficient and inclusive market and trade strategies. These strategies contribute to the sustainable development of the fish trade sector (including the economic, social and environmental aspects) and, at the same time, contribute to improving food and nutrition security and strengthening livelihood opportunities and are directly linked to SO4.

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The PDF can be accessed directly at:
www.fao.org/3/cb7153en/cb7153en.pdf

The document card can be found here:
www.fao.org/documents/card/en/c/cb7153en

FAO 2021

Acuicultura del caracol rosado - Fases de crianza y vivero– *Rome*

El presente documento describe técnicas para la producción de semilla del caracol rosado, Aliger gigas, bajo condiciones controladas. Se suministra información básica de la especie que incluye la descripción general de su biología, anatomía, hábitat y distribución geográfica, con aspectos de nutrición, reproducción y la descripción del ciclo de vida, así como la infraestructura básica y necesaria de un criadero y vivero para el desarrollo de las técnicas embrionario, el cultivo larvario y postlarvario hasta la obtención de semillas aptas para el cultivo en el exterior.

The PDF can be accessed directly at:
www.fao.org/3/cb6663es/cb6663es.pdf

The document card can be found here:
www.fao.org/documents/card/es/c/cb6663es

FAO 2021

FAO's work on climate change - Fisheries and aquaculture 2020 – *Rome*

The Food and Agriculture Organization of the United Nations (FAO) works towards ending hunger and poverty while using precious natural resources sustainably. The fisheries and aquaculture sector makes substantial contributions to food security, livelihoods and global trade. Global production of fish and other aquatic animals continued to grow and reached 179 million tonnes in 2018, and about 59.5 million people were engaged in the primary sector of capture fisheries and aquaculture. Fishery net exports generate significantly more revenue for developing countries than other agricultural commodities such as rice, coffee and tea. Millions of people are struggling to maintain reasonable livelihoods through the fisheries and aquaculture sector. These are the people who are the most vulnerable to the impacts of climate change. Climate change adds to the many threats and obstacles that already confront them in their day-to-day lives. Particular attention must be given to the most vulnerable if the sector is to continue to contribute to meeting global goals of poverty reduction and food security. This publication presents FAO's work on climate change and fisheries and aquaculture. It includes examples of FAO's support to countries so that they are better able to adapt to the impact of climate change in the fisheries and aquaculture sector. It also brings together FAO's most up-to-date knowledge on climate change, including a portfolio of adaptation tools and measures used to support countries' climate commitments and action plans.

The PDF can be accessed directly at:
www.fao.org/3/cb3414en/cb3414en.pdf

The document card can be found here:
www.fao.org/documents/card/en/c/cb3414en

FAO 2021

Tilapia lake virus disease strategy manual– *Rome*

The purpose of this manual is to inform national policymakers and other stakeholders of issues related to the development of contingency plans for responding to outbreaks of tilapia lake virus disease (TiLVD), which has caused substantial mortalities, up to 90 percent, in populations of both wild and farmed tilapia in Asia, the Americas, and Africa. The causative agent for this disease is tilapia lake virus (TiLV), which infects the liver, spleen, kidney, heart, gill tissues, brain, connective tissues of muscle, and reproductive organs of tilapia. Outbreaks of TiLVD not only have devastating economic effects on producers, but also can result in a variety of socio-economic impacts on surrounding communities. It would, therefore, be prudent to implement strategies for the prevention of TiLVD and to develop contingency plans to eradicate, contain, and mitigate the impacts of the disease when outbreaks occur. This manual provides information on: 1) the nature of TiLVD; 2) diagnosis; 3) prevention and control; 4) epidemiology; 5) principles of eradication, containment and mitigation; and 6) policy development issues.

The PDF can be accessed directly at:
www.fao.org/3/cb7293en/cb7293en.pdf

The document card can be found here:
www.fao.org/documents/card/en/c/cb7293en

FAO 2021

Risk profile - Group B Streptococcus (GBS) – Streptococcus agalactiae sequence type (ST) 283 in freshwater fish – *Bangkok*

In Singapore during 2015, Group B Streptococcus (GBS) sequence type 283 (ST283) caused the only reported foodborne outbreak of invasive GBS disease. Over 20 percent of cases were healthy adults without comorbidities, which is unusual for GBS. The outbreak was linked to the consumption of raw freshwater fish.

Subsequent investigations found that ST283 GBS has been common among GBS causing disease in humans and in tilapia across Southeast Asia for at least 20 years, whereas it was almost non-existent outside this region. Given the novelty of the outbreak, this risk profile consolidates the current knowledge to identify data gaps about GBS ST283 along the freshwater fish supply chain in Southeast Asia.

Although GBS fish infection can present with few clinical signs of disease, outbreaks of GBS in high intensity tilapia aquaculture can result in severe infection with mortalities of up to 80 percent. These outbreaks are largely undocumented but likely have a wide effect on aquaculture, given its economic and social importance across Southeast Asia.

Given the multitude of data gaps, the risk posed by GBS ST283 from consumption of freshwater fish remains highly uncertain. Potential risk management options start with the application of good aquaculture practices and good food safety measures throughout the supply chain.

The PDF can be accessed directly at:
www.fao.org/3/cb5067en/cb5067en.pdf

The document card can be found here:
www.fao.org/documents/card/en/c/cb5067en

Calendar of Events

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MARCH 2022

Aquaculture Africa 2022

Bibliotheca Alexandrina, Egypt
March 25-28, 2022 (Postponed due to COVID)
All Informations on: www.was.org

MAY 2022

World Aquaculture 2022

Mérida, Mexico. 24-27 May 2022
All Informations on: www.was.org

SEPTEMBER 2022

Aquaculture Europe 2022

Rimini, Italy. Sept 27-30 2022
All Informations on: www.aquaeas.org

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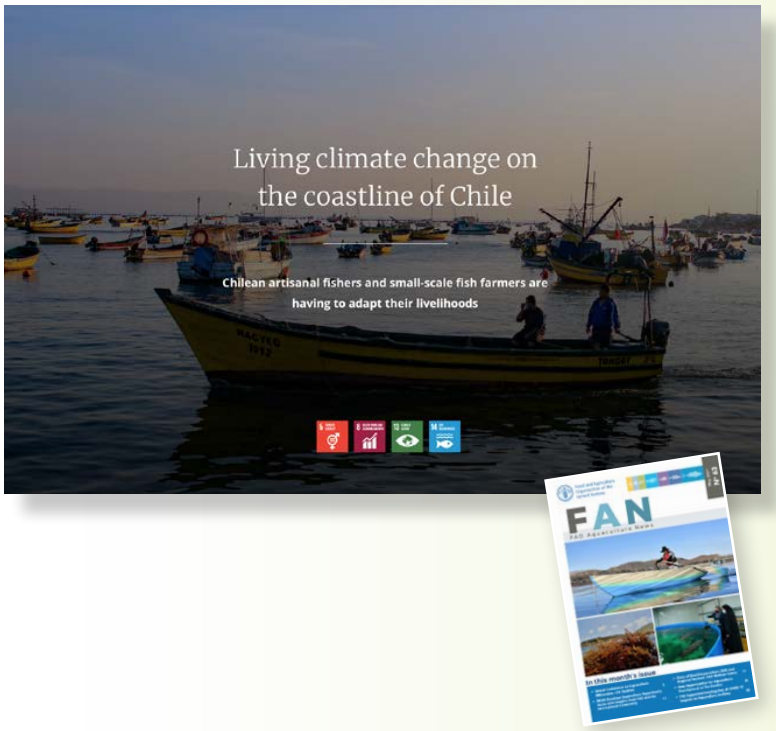
Raising the Visibility of Aquaculture Through FAO Stories

www.fao.org/home/stories-archive/en/



Living climate change on the coastline of Chile

Chilean artisanal fishers and small-scale fish farmers are having to adapt their livelihoods

In the coastal community of El Manzano in southern Chile, artisanal fishers are on the frontline of the climate crisis. Of the 400 people who live in this picturesque town, most rely on small-scale fishing or collecting shellfish and seaweed to make a living. But dramatic environmental changes are forcing artisanal fishers and small-scale fish farmers along the country's 6 400-kilometre coastline to modify or supplement their activities, as the availability and abundance of species are affected.

Read the FAO Story here:
www.fao.org/fao-stories/article/en/c/1449738/
And see the article in FAN 63 here:
www.fao.org/3/cb4850en/cb4850en.pdf

Tapping into aquatic resources to lift rice production

Biodiversity on rice-fish farms helps ensure food security for Laotian communities

Bunlom Phantavong comes from a long line of rice farmers in the southern Savannakhet province of the Lao People's Democratic Republic (Lao PDR). He is proud of how rice production has been passed down from one generation to another but admits he is struggling with the regular approaches to farming. Now, farmers are going back to an ancient, time-tested practice that FAO is helping them rediscover: rice-fish farming. Promoting species diversification and biodiversity is a simple approach that encourages farmers to use the resources they already have so they can increase the production of rice and aquatic animals while reducing the use of fertilizers and pesticides.

Read the FAO Story here:
www.fao.org/fao-stories/article/en/c/1439638/
And see the article in FAN 60 here:
www.fao.org/3/ca5223en/ca5223en.pdf

IYAFA 2022 *is here*

The United Nations General Assembly declared 2022 the International Year of Artisanal Fisheries and Aquaculture (IYAFA 2022) and identified FAO as the lead agency. Celebrating the Year in 2022 follows a trend of highlighting that fisheries and aquaculture is about people as much as it is about fish. Its objective is to focus world attention on the role that small-scale fishers, fish farmers and fish workers play, thereby increasing global understanding and action to support them. A key step is to enter the celebration of the Year into all national calendars and action plans across the globe to ensure that governments and relevant organisations alike start planning and getting creative on how to give small-scale fish producers the global acknowledgment they deserve.

The official launch of IYAFA occurred on 19 November 2021, weaving technical information, political commitments and stories from the ground in a manner that was entertaining and informative, and the included Margarita Lizarraga medal ceremony allowed for an even more personal connection with the world of small scale fisheries.

Watch the promo video here: https://youtu.be/0s6N_89xXIU

Watch the Launch event here: www.fao.org/webcast/home/en/item/5716/icode

Find all information on the IYAFA website: www.fao.org/artisanal-fisheries-aquaculture-2022/home/en

Want to get involved? Contact us at: IYAFA@fao.org

Small-scale fishers and fish farmers are proof that small actions can have big impacts, and IYAFA is all about supporting empowering them. Join us for the celebrations throughout 2022!

FAN
FAO Aquaculture News

Sustainable Aquaculture
FAO Fisheries and Aquaculture Division
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla, 00153 Rome, Italy
E-mail: NFI-Inquiries@fao.org

World Aquaculture Performance Indicators (WAPI) started with an FAO's endeavour to develop user-friendly data analysis tools, also a potential research and educational tool. It has now developed into a mechanism to compile, generate and disseminate information and knowledge to facilitate evidence-based policymaking and sector management in aquaculture development. Key WAPI products include (i) technical papers on methodologies (e.g. demand projection and fish GDP evaluation); (ii) data analysis tools (currently for FAO internal use only); (iii) discussion papers on key aquaculture commodities (e.g. seaweeds and tilapias); (iv) factsheets, such as WAPI factsheets on aquaculture growth potential; and (v) policy briefs. For more information about WAPI and access to its information and knowledge products, visit the WAPI webpage at www.fao.org/fishery/statistics/software/wapi/en

FAO Aquaculture News (FAN) is issued twice a year by the FAO Fisheries and Aquaculture Division, Rome, Italy. It presents articles and views from the FAO aquaculture programme and discusses various aspects of aquaculture as seen from the perspective of both headquarters and the field programme. Articles are contributed by FAO staff from within and outside the Fisheries Division, from FAO regional offices and field projects, by FAO consultants and, occasionally, by invitation from other sources. FAN is distributed free of charge to various institutions, scientists, planners and managers in member countries and has a current circulation of about 1 300 copies. It is also available on the FAO webpage: **www.fao.org/fishery/publications/fan**

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