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In this month's issue

EDITORIAL

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Fish farming high on the global food system agenda in 2020

Dear reader,

First of all, let me start with a heartfelt "Thank you" to all who provided feedback on the 60th edition of *FAN*. It is reassuring to know how much you appreciate and how useful you find the information provided in *FAN*, and your feedback serves as an important incentive for all contributors and the editorial team to continue our work for you.

We hope you will also find this edition interesting and stimulating. In addition to the regular sections from the desks of our statistician and fish health specialist, this issue contains highlights of FAO work around the world, particularly articles that present work in countries and (sub-)regions where sustainable aquaculture has great scope for further development, including the Maghreb, the United States of America, the Balkan and Caucasus countries, and Southern Africa, among others. The thematic articles are both rich and diverse, covering topics ranging from aquaculture in desert and arid lands, integrated rice-fish systems, new developments in alternative feed ingredients, dimensions of legal/policy/governance improvements, and tracking of farmed types of aquatic genetic resources

This edition is being published during the interim period of three important intergovernmental events: the 10th Session of the Committee on Fisheries (COFI) Sub-Committee on Aquaculture (COFI-SCA 10), which was held in Trondheim, Norway, in August 2019; the 34th Session of COFI to be held in FAO headquarters in July 2020; and the 11th Session of the COFI Sub-Committee on Aquaculture (COFI-SCA 11) to be held in Mexico in 2021. The guidance received from FAO Members at the COFI-SCA 10 in Trondheim was clear, direct and explicit: Fish has a great role to play in ending hunger, securing food supplies and promoting good health and dietary practices, and therefore FAO should emphasize even more the contribution of sustainable aquaculture to food security and nutrition, poverty alleviation and human development.

This emphasis has already begun, notably with the FAO International Symposium on Fisheries Sustainability last November, where FAO's senior management reinforced the interlinkage and interdependence between fisheries and aquaculture, and their collective relevance for sustainable development. Looking

COVER PHOTOS: (clockwise from top) Salmon cage production in Ocean Farm 1 (Norway), ©FAO/A. Stankus; producing farm-made fish feeds using locally available raw materials in Kyrgyzstan, ©FAO/V. Ushakov; Clarias catfish, (United States of America), ©FAO/I. Nurzia Humburg.

EDITORIAL

forward, 2020 will be a "super year" for fisheries and aquaculture, with a series of high-impact events, in the hopeful assumption that the corona virus pandemic will improve soon. Starting with the UN Ocean Conference (Lisbon, Portugal, June) – and followed by the celebration of 25 years of the Code of Conduct for Responsible Fisheries during COFI 34 (Rome, Italy, July), the Our Ocean Conference (Palau, August), the Conference of the Parties of the Convention on Biological Diversity (Kunming, China, October), World Aquaculture 2020 (Singapore, December) and the Global Conference on Aquaculture 2020 (Shanghai, China, October) – this will be an exciting and busy year, providing the opportunity to highlight the significance of aquaculture on the global stage.

FAO Members at COFI SCA 10 stressed that certain aspects of aquaculture development deserve special attention: the promotion of *nutrition-sensitive* aquaculture, the sustainable development, management and use of aquatic genetic resources, the importance in preventing and managing aquatic animal disease risks in aquaculture, and the relevance of innovation and supporting, upscaling and transferring new technology and practices to increase efficiency, combat environmental degradation and adapt to climate change. The aquaculture sector is booming, which is all the more reason to strive to implement good governance and appropriate management strategies to ensure the sustainability of its expansion, and guide its direction towards maximum contribution to the targets of the Sustainable Development Goals (SDGs). To this end, FAO has been asked to facilitate the development of guidelines for sustainable aquaculture through a process of regional and expert consultations and, at the same time, to develop a global sustainable aquaculture programme towards the harmonized implementation, partnership and advancement of the sector.

With this momentum and with impeccable timing, the Global Conference on Aquaculture 2020 (GCA 2020) will provide a space to join hands with representatives of governments, academia, the private sector and civil society to shape our collective vision for the future of aquaculture. We hope you will join us in Shanghai, China, as together we seek answers to the pivotal questions: How best can aquaculture contribute to sustainable development and help achieve the SDGs? What will aquaculture look like in 2030? And most importantly, How can we work together to make it happen? This GCA 2020 builds upon a long history of collaboration with partners around the world, and indeed we will take the opportunity to join our friends and colleagues of the Network of Aquaculture Centres in Asia-Pacific to celebrate its 30th anniversary, taking a moment to look back on the major achievements in the region, even as we look to the horizon at the future of aquaculture. And with the China Fisheries and Seafood Expo (Qingdao, October) scheduled back to back with the GCA, hopefully all stakeholders will see this as a great incentive to join us in China in October this year.

Suffice to say, sustainable aquaculture, especially focusing on food security and nutrition, is high on FAO's agenda. Stay tuned and follow us on social media for the latest developments, and please do watch out for the next issue of *FAN*, scheduled for release just ahead of GCA 2020 when we look forward to sharing our thoughts with you on the accelerated implementation of sustainable aquaculture.

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Sea cucumbers, a high-value product, offer livelihood generating opportunities for farmer cooperatives in Zanzibar, Tanzania

GLOBAL AQUACULTURE UPDATES

Brief Overview of World Aquaculture Production

An Update with Latest Available 2018 Global Production Data

What was the total aquaculture production in 2018?

FAO's Global Aquaculture Production Statistics Database, updated in March 2020, covers 1950–2018 with production quantity and 1984–2018 with farmgate value. According to the new data, world aquaculture output in 2018 was 114.5 million tonnes, including 82.1 million tonnes of aquatic animals, 32.4 million tonnes of aquatic algae and 26 000 tonnes of ornamental sea shells and pearls. Compared with the data published in 2019, the most pronounced change in the new data is the downward revision of the 2017 production of farmed aquatic animals from 80.1 million tonnes to 79.6 million tonnes, resulting mainly from the data revision for Indonesia, the world's third-largest aquaculture producer if seaweed farming is not included. The new data reveal that the world production of aquatic animals grew by 3.2 percent (2.5 million tonnes) in 2018, while the average annual growth rate during 2001–2018 was 5.3 percent. Farmed aquatic algae fell by 0.7 percent (227 000 tonnes). Asia contributed 85.6 percent to the increased output of 2.5 million tonnes of farmed aquatic animals in 2018.

How many aquatic species are farmed in aquaculture?

This frequently asked question is extremely difficult to answer. Perhaps no individual or agency is able to tell the exact number of aquatic species and hybrids employed in aquaculture production in the world. Nonetheless, FAO's global aquaculture data provide both qualitative and quantitative information in monitoring the great diversity of aquatic species used for aquaculture. In the new global database[1], which is updated annually by FAO based on country reporting, the total diversity of aquaculture production, ever recorded amounts to 622 "species items". A species item is the smallest statistical unit, and this

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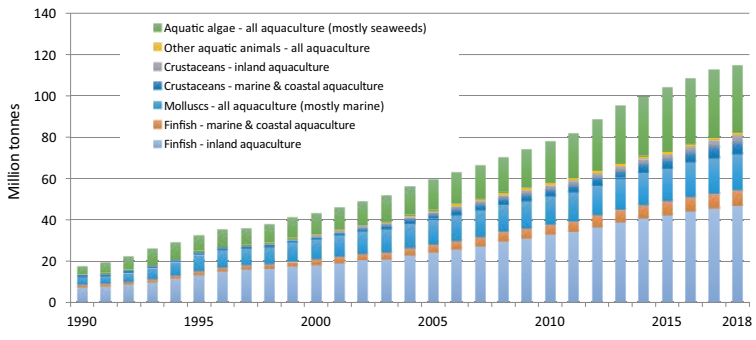
FIGURE 1 – World aquaculture production of major farmed species groups from major types of aquaculture practices, 1990–2018



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

TABLE 1 – World aquaculture production of aquatic animals by region (1 000 tonnes, in live weight)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Africa	989	1 286	1 396	1 490	1 620	1 717	1 778	1 976	2 086	2 196
Americas	2 466	2 515	2 775	2 991	2 986	3 349	3 275	3 363	3 601	3 799
Asia	49 006	51 233	52 778	55 988	59 437	62 348	64 597	68 012	70 650	72 820
Europe	2 517	2 523	2 646	2 829	2 730	2 904	2 943	2 947	3 014	3 075
Oceania	179	188	194	183	177	187	179	205	210	205
World	**55 157**	**57 744**	**59 789**	**63 480**	**66 952**	**70 506**	**72 771**	**76 504**	**79 561**	**82 095**

list includes 466 individual species, 7 interspecific hybrids of finfish, 92 genus level of species group, 32 family level species groups and 25 species groups aggregated at order or higher levels.

Unfortunately, counting the number of "species items" is misused by many as the total number of farmed aquatic species. For example, in the FAO database, in addition to European seabass (*Dicentrarchus labrax*) and spotted seabass (*D. punctatus*), there is also the production data of "Seabass nei [not elsewhere included]" (*Dicentrarchus* spp.) when the reporting government was not sure of the exact species produced. The result of "3" would be correct when counting the number of species items. In reality, though, the genus *Dicentrarchus* has only two species.

But this is not the full picture. Between 200 and 300 other species, including some hybrids, are known to have been farmed in aquaculture in addition to the said 466 species and 7 hybrids. Their absence from the FAO global production statistics is due to different practical reasons, such as the difficulties faced in field data collection, the highly aggregated species grouping in the standard list of species in national statistics system, and data confidentiality according to national law. As part of FAO's efforts to enhance the resolution of our answer to "How many species are farmed in aquaculture", the first ever Report of *The State of the World's Aquatic Genetic Resources for Food and Agriculture*,[2] following an in-depth, country-driven reporting process, helped illuminate the additional diversity of farmed species. For more information on ongoing initiatives to capture information on farmed aquatic genetic resources below the species level, see the article on pages 40-42.

Data and statistics are essential part of FAO's task, to support stakeholders in the conservation, management and use of their aquatic resources, and the process is continually improving. To that end, this figure and data table are presented for *FAN* readers to have a quick glance at world aquaculture. More detailed figures and data tables, along with analysis, will be available in the 2020 report of *The State of World Fisheries and Aquaculture* (SOFIA), to be published by summer 2020.

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A wide range of wild and farmed aquatic products from rivers, ponds and rice fields form part of a healthy diet in Lao PDR

2. **www.fao.org/3/CA5256EN/CA5256EN.pdf**

Updates on Implementation of GCP/GLO/979/NOR: Improving Biosecurity Governance and Legal Framework for Efficient and Sustainable Aquaculture Production

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Clockwise: Second Multi-stakeholder Consultation (PMP/AB2) hosted by the World Organisation for Animal Health (Paris, January 2019); risk-based surveillance round-table discussions hosted by the Norwegian Veterinary Institute (Oslo, April 2019); national seminar on aquaculture biosecurity hosted by MMAF (Jakarta, May 2019); small-scale intensive shrimp culture, field mission (Bali, May 2019)

Initiated in January 2019, this project has two components, namely, aquaculture biosecurity and aquaculture legislation. The overall objective of this Norwegian Agency for Development Cooperation -funded project is to support countries in the sustainable development of their aquaculture industry through improving systems and practices in biosecurity, enhancing and enabling legal frameworks, and promoting responsible and sustainable aquaculture practices. This article highlights the accomplishments pertaining to the aquaculture biosecurity component of the project.

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Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB). The Second Multi-stakeholder Consultation (PMP/AB2), hosted by the World Organisation for Animal Health (Paris, January 2019), discussed, elaborated upon and agreed on guidance (indicators, checklists, tools) and action points needed to roll out the PMP/AB. A third follow-up meeting was held at FAO headquarters in March 2019; this meeting came up with a clear definition of PMP/AB, expected results and key considerations for each stage of the PMP/AB (see *FAN* 58, pages 9–11).

The PMP/AB refers to a **pathway** aimed at enhancing **aquaculture biosecurity** capacity by building on existing frameworks, capacity and appropriate tools using risk-based approaches through public-private partnerships. PMP/AB is expected to result in sustainable:

– reduction of burden of disease;
– improvement of health at the farm and national levels;
– minimization of global spread of diseases;
– optimization of socio-economic benefits from aquaculture;
– attraction of investment opportunities into aquaculture; and
– achievement of One Health goals.

In the context of PMP/AB, **aquaculture biosecurity** refers to "the cost-effective management of risks posed by infectious agents to aquaculture through a strategic approach at enterprise, national and international levels with shared public-private responsibilities".

Risk-based surveillance for aquatic animal diseases. A round-table discussion (Oslo, Norway, April 2019) hosted by the Norwegian Veterinary Institute achieved the following: (i) participants discussed, validated

and improved the FAO 12-point surveillance checklist; and (ii) they discussed detailed plans for pilot testing using a target disease *Enterocytozoon hepatopenaei* (EHP) (= hepatopancreatic microsporidiosis) in *Penaeus vannamei* cultured in small-scale intensive and traditional polyculture (+ milkfish) systems in one district (Jembrana) in Bali, Indonesia.

A field mission conducted in Indonesia accomplished the following: (i) the National Seminar on Aquaculture Biosecurity Governance organized by the Ministry of Maritime Affairs and Fisheries (MMAF). Dr Ir. Slamet Soebjakto, Director-General of Aquaculture and Director of Pak Coco and a few other MMAF officials were in attendance; and (ii) round-table discussions and field visits were organized to support the design and pilot testing of an active surveillance for EHP, which provided detailed guidance to the local Indonesia team. Pilot testing commenced in August, and regular updates are being provided through real-time messaging. The next activity will be a surveillance data analysis workshop to be held in 2021.

Aquaculture health economics. A second round-table discussion (Oslo, Norway, April 2019) recognized the importance of the subject, limitations and the way forward. During this event, Professor J. Rushton of the University of Liverpool and project leader of the Global Burden of Animal Diseases (GBADs) programme, delivered a presentation, providing information about the programme and potential engagement and collaboration. FAO is now a member of the GBAD network **(www.animalhealthmetrics.org)**. The meeting concluded on the possibility of exploring case studies that will collect data and/or do a cost-benefit analysis based on historical data.

Antimicrobial resistance in aquaculture. Awareness-raising activities on antimicrobial resistance were undertaken for Indian fish farmers during the World Aquaculture Society Asia-Pacific Chapter conference held in Chennai, India, in June 2019. Additional awareness-raising activities for Indonesia will be held in 2020 (during a follow-up workshop) and Viet Nam (during a proposed training course on aquatic epidemiology and surveillance for non-specialists and for developing countries).

As a way forward, the 10th session of the Committee on Fisheries Sub-Committee on Aquaculture (Trondheim, Norway, August 2019) welcomed the work by FAO on the PMP/AB and requested further development of the PMP/AB and associated tools and mechanisms, such as governance, centres for collaboration, assessment tools, surveillance checklists, biosecurity action plans, risk analyses, and guidance on public-private partnerships. The Sub-Committee also recognized the importance of developing an assessment tool on aquaculture health economics and emergency preparedness, aligning with the initiatives of GBADs that could support decision-makers (at policy, production and service-provider levels) in ensuring effective resource allocation and creating an environment for increased investment opportunities.

As of October 2019, the project has been extended until the end of December 2020 with an increased budget allocation for the aquaculture biosecurity component. Newly planned activities for the end of 2019 and during 2020 include the following:

1. Round-table discussions: Moving forward through lessons learned on response actions to aquatic animal disease emergencies (16–18 December 2019, FAO headquarters, Rome).
2. Establishment and convening of the PMP/AB Technical Working Group and pilot testing of PMP in selected countries (first quarter 2020).
3. Organization of a fisheries/aquaculture and veterinary authorities collaboration meeting in Africa, Asia, and Latin America and the Caribbean (throughout 2020).

SEE ALSO

www.fao.org/north-america/news/detail/en/c/1203328/

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Global Conference on Aquaculture Millennium + 20

26–30 October 2020 | Shanghai, China

MESSAGE FROM THE GCA SECRETARIAT REGARDING THE CORONOVIRUS (COVID-19) OUTBREAK

As this issue of FAN is being published, many countries are facing the severe challenge of the COVID-19 pandemic. The health and wellbeing of all GCA 2020 participants is the first and foremost priority of the GCA organizers. We are in regular contact with relevant health authorities and follow closely the guidance of the World Health Organization. For the time being and until further notice, the preparations for the GCA continue as planned but please make sure to regularly consult the website **www.aquaculture2020.org** for updates.

An effective enabling environment, together with cold, deep water with strong currents, make salmon culture in Norway a model of successful intensive aquaculture

Feeding an expected global population of 9 billion by 2050 with nutritious food is a daunting challenge that is engaging hundreds of millions of farmers, food processors, traders, researchers, technical experts and leaders the world over. Fish and other aquatic products from aquaculture can and will play a major role in meeting these dietary demands, while also meeting the food security needs of the poor. Aquatic food is considered very important for a nutritious, healthy and balanced diet complete with essential micronutrients, especially for mothers and children. Increasing production alone is not enough, however, and thus enhancing training and capacity, and linking production to regional and global markets through value chain development is required. Addressing hazardous work in the sector and supporting business opportunities for everyone, including youth and women, is essential to maximize the contribution of aquaculture to decent employment, livelihood generation and poverty eradication. Currently, aquaculture employs at least 26 million workers in production alone, in addition to millions of jobs generated in input supply chains, food/fish processing, distribution and trade and retail. Overall, the contribution of aquaculture to food system transformation can be significant. Yet, to realize the maximum contributions of the sector towards achieving the targets set by the Sustainable Development Goals and Agenda 2030, coordinated and accelerated actions are required.

Recognizing the critical importance of aquaculture to close the projected gap between supply and demand of fish, and the need to exchange and discuss reliable information to further enhance its contribution to sustainable development, FAO, at the request of its Members, is collaborating with the Network of Aquaculture Centres in Asia-Pacific (NACA) and the Ministry of Agriculture and Rural Affairs (MARA) of the People's Republic of China, to organize the **Global Conference on Aquaculture Millennium + 20 (GCA 2020), 26–30 October 2020, Shanghai, China.**

Registration is free, and the procedure will be announced soon on the GCA 2020 website: **www.aquaculture2020.org**

With the rapid, but uneven, development of aquaculture in recent decades, a need exists to review current practices and policies for a better understanding of gaps and challenges that could

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be addressed through enhanced investment, policy, technology, innovation, partnership, education and knowledge. In addressing global challenges such as impacts of climate change, risks to biodiversity or assurance of economic viability and social equity together, the actions of all stakeholders will take a coordinated and global effort in order to enhance the contribution of aquaculture for food and sustainable development to benefit people and the planet. The challenges are too big for any one agency to handle, and will require collaboration among strong partners who can build synergies through their complementary strengths.

Conference objectives

Under the overall conference theme "Aquaculture for Food and Sustainable Development", GCA 2020 aims to bring together stakeholders from government, business, academia and civil society to identify policy and technology innovations, investment opportunities and fruitful areas of cooperation in aquaculture that can drive its sustainable development. A key output from GCA 2020 – the *Shanghai Declaration* – will highlight the principles and strategic pathways to optimize the role that aquaculture will play in achieving the Sustainable Development Goals, and the pledge of "Leaving no one behind".

Specifically, the GCA 2020 will:

- review the status, trends and emerging issues in aquaculture development;
- evaluate the progress of aquaculture development in light of previously recommended strategies and policies at the regional and global levels;
- identify needs, opportunities and challenges in aquaculture and its contributions to sustainable development; and
- build consensus on priorities and actions needed for advancing aquaculture as a globally competitive and sustainable food production sector.

The main outputs of the Conference are the following:

- The *Shanghai Declaration* will highlight the principles and strategic pathways to maximize the contribution of sustainable aquaculture in achieving the Sustainable Development Goals.
- Regional reviews and a global synthesis will provide information on the status, trends and emerging issues in aquaculture development globally and in the regions.
- Conference Proceedings and technical documentation will synthesize the information and debate from each of the thematic sessions.

The *Shanghai Declaration* is expected to provide a roadmap for the future development of aquaculture, facilitate collaboration among all concerned stakeholders and enable implementation of recommended actions. All Conference outputs will be freely available and will provide information and advice to the FAO Committee on Fisheries (COFI) Sub-Committee on Aquaculture, COFI itself, as well as NACA and other regional Networks and Commissions.

Previous Global Conferences on Aquaculture

GCA 2020 will be the fourth in a series of development-oriented conferences that have influenced global aquaculture development:

1. The FAO Technical Conference on Aquaculture (Kyoto, Japan, 1976) developed *The Kyoto Strategy for Aquaculture Development*[1] and facilitated the transformation of aquaculture from a traditional to a science-based economic activity. It promoted technical cooperation among developing countries to expand aquaculture development.
2. The FAO/NACA Conference on Aquaculture in the Third Millennium (Bangkok, Thailand, 2000)[2] adopted *The Bangkok Declaration and Strategy on Aquaculture Development Beyond 2000*,[3] which articulated 17 strategic elements addressing the role of aquaculture in alleviating poverty, enhancing food security, and maintaining the integrity and sustainability of natural resources and the environment. The Strategy suggested measures that incorporate aquaculture into the development programmes of the public and private sectors.
3. The FAO/NACA Global Conference on Aquaculture Millennium +10 (Phuket, Thailand, 2010)[4] adopted *The Phuket Consensus:* a *re-affirmation of commitment to the Bangkok Declaration*,[5] which recognized the continued value and relevance of the Strategy and identified seven elements that require further strengthening in order to enhance sustainable growth of the sector.

Organization

The Conference Secretariat is made up of FAO, MARA, and NACA. The Secretariat coordinates the overall implementation of the conference, prepares communication materials and provides secretariat support to the organizing committees.

The GCA 2020 will be hosted by the Bureau of Fisheries (MARA), the Shanghai Municipal Agriculture and Rural Affairs Commission, and the Shanghai Ocean University.

1. **www.fao.org/3/AC863E/AC863E00.htm**
2. **www.fao.org/3/Y2815E/Y2815E00.htm**
3. **www.fao.org/3/a-ad351e.pdf**
4. **www.fao.org/3/i2734e/i2734e.pdf**
5. **www.fao.org/fishery/docs/DOCUMENT/aquaculture/aq2010/Phuket_Consensus_13-12-2010.pdf**

The co-hosts include the Chinese Academy of Fishery Sciences, the China Society of Fisheries, China Fisheries Association, China Overseas Fisheries Association, China Aquatic Products Processing and Marketing Alliance, China Fishery Mutual Insurance Association and the China Algae Industry Association.

Programme

An International Programme Committee has been convened, which has identified nine themes of current and future relevance for the sector, to be developed into thematic sessions of the Conference.

The working titles of the nine thematic sessions for the conference are:

1. aquaculture systems;
2. aquaculture innovation and technical solutions;
3. transforming aquaculture to achieve the Sustainable Development Goals;
4. aquaculture feed and feeding;
5. sustainable management and improvement of aquatic genetic resources and seed supply;
6. biosecurity and aquatic animal health management;
7. aquaculture policies, planning and sectoral governance;
8. social and human dimensions of aquaculture; and
9. value chains and market access for aquaculture products.

A parallel poster session will showcase emerging research relevant to the thematic areas and provide opportunity for early career participants to interact with the conference attendees. Posters submitted by youth will automatically be entered into a poster competition. Winners will receive an opportunity to present a "lightening presentation" during a plenary session on the last day as an opportunity to present to a large audience. Winners will also be invited to prepare a brief article for the *FAO Aquaculture Newsletter* and will have their names included in the Conference Proceedings.

In addition, FAO in collaboration with partners, is preparing a global synthesis of *The State of World Aquaculture 2020*, which will be presented on the first day following the official opening and keynote speeches. Six regional reviews will be presented during plenary sessions. There will be invited guest lectures and one or more side events, which will highlight key topics and emerging issues. Technical presentations under the themes will include expert panel discussions covering needs, opportunities and challenges for aquaculture. Delegates will have the opportunity to provide input on the key messages and recommendations of each theme. NACA's 30th anniversary will be celebrated during the Conference reception. An international exposition of the aquaculture industry, organized by Shanghai Ocean University and NACA, will showcase achievements on sustainable aquaculture developments, with new technologies, products and innovations in aquaculture from country and region partners.

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Harvesting a local farmed type of carp in a Globally Important Agricultural Heritage Systems (GIAHS) designated site in Qingtian County, Zhejiang province, P.R. China

The Local Organizing Committee is arranging an optional field trip to visit aquaculture facilities on 29 October. Alternatively, participants may take advantage to visit the China Fisheries & Seafood Expo in the city of Qingdao from 28-30 October.

Opportunities for contributors and sponsors are still available, and interested parties are invited to contact the organizers.

Date	Activity
Sunday, 25 October	– Arrival and registration
Monday, 26 October	– Official opening – Invited keynote speeches and plenary presentations – Global synthesis and regional reviews – Evening: Conference reception
Tuesday, 27 October	– Guest lectures – Parallel thematic presentations and panel discussions
Wednesday, 28 October	– Conclusions and recommendations from panels – Student poster competition awards – Presentation of the Shanghai Declaration – Official closing
Thursday, 29 October	– Field trip to aquaculture facility (optional and at cost)
Friday, 30 October	– Departure

Note: The poster session will be organized in parallel.

Find more information at the following:

E.mail: **GCA@fao.org**

Website: **www.aquaculture2020.org**

Looking forward to seeing you in Shanghai!

FAO Continues its Efforts and Actions on Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB)

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Clockwise from top left: First Multi-Stakeholder Consultation meeting (PMP/AB1) in Washington, DC, USA (April 2018); Technical Working Group meeting (PMP/AB TWG1) in Rome, Italy (March 2019); another Technical Working Group meeting (PMP/AB TWG2) in Washington, DC, USA (July 2019); Aquaculture Biosecurity meeting in Qingdao, China (September 2019)

The Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB) was first introduced in *FAN* 58 (April 2019) as a new initiative and represents a paradigm shift in dealing with the risk of diseases in aquaculture. It has come a long way since the first multistakeholder meeting hosted by the World Bank in Washington, DC (April 2018). A second consultation, in Paris (January 2019), hosted by the World Organisation for Animal Health (OIE) was followed by a third more technical meeting held at FAO in Rome (March 2019) (see related article on providing updates on the related project: Improving Biosecurity Governance and Legal Framework for Efficient and Sustainable Aquaculture Production, pages 7-8). More recent PMP/AB related events included another technical working group meeting held at the FAO Liaison Office in Washington, DC (July 2019) and an aquaculture biosecurity meeting hosted by the Yellow Sea Fisheries Research Institute of the Chinese Academy of Fishery Sciences in Qingdao, China (September 2019).

All these events resulted in further consensus building, a better understanding of the concepts, principles, benefits and applications, and a refinement of guidance and other tools for pilot testing of the PMP/AB. The active engagement of governance authorities, producer sectors and academia clearly indicates a collective aspiration towards public and private sector co-management of biosecurity, risk ownership and strengthened partnerships which can pave the way for long-term commitment to risk management.

Each country has an entry point for the PMP/AB using one of the below scenarios:

- **Scenario 1**: Country with no aquaculture strategy or National Strategy on Aquatic Animal Health (NSAAH), but has ongoing aquaculture or has initiated aquaculture activities.
- **Scenario 2**: Country with NSAAH or other strategies

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from FAO projects or other assistance projects; certain levels of implementation – how can these be used to fit the context of the PMP/AB?
- **Scenario 3**: Country with advanced biosecurity strategies; what bottlenecks/lessons and good practices can be used? Updated to fit the context of the PMP/AB.
- **Scenario 4**: Countries sharing waterbodies or transboundary watersheds; regions with regional biosecurity strategies – updated within the context of the PMP.

Equally important is the ongoing recognition by FAO statutory bodies of the importance of aquaculture biosecurity as one of the biggest limiting factors to sustainable aquaculture, and of the need to put in place biosecurity systems in parallel to any aquaculture development. The 33rd Session of the Committee on Fisheries (COFI) (July 2018) took note of the development of PMP/AB and the need to build the capacity of FAO Member Countries to better manage biosecurity (*FAN* 59, October 2018). The recently concluded 10th Session of the COFI Sub-Committee on Aquaculture (COFI-SCA) had outstanding outcomes related to its agenda on preventing and managing aquatic animal disease risks in aquaculture (**www.fao.org/3/na265en/na265en.pdf**). This agenda item received the highest number of interventions, a strong indication of the attention from Members and the need, interest and commitment to look at this subject seriously.

COFI-SCA 10 made a number of decisions on PMP/AB, namely: (i) welcomed the PMP/AB and further highlighted the importance of improved aquaculture biosecurity in reducing disease burden, improving health at the farm and national levels, minimizing global spread of diseases, optimizing socio-economic benefits from aquaculture, attracting investment opportunities, and achieving One Health goals; (ii) recommended COFI to consider the development, as part of FAO's global aquaculture sustainability programme, of a multi-donor assisted long-term component on aquaculture biosecurity, including the five pillars (one of which is the PMP/AB); (iii) encouraged commitment on resource mobilization; (iv) urged the pilot testing of the PMP/AB; (v) emphasized the need to take into consideration the OIE standards and tools in the application of the PMP/AB and enhanced collaboration with relevant international bodies; (vi) stressed the importance of microbiome studies and the need for developing microbial management protocols as part of good aquaculture practices; (vii) requested the formation of an FAO Technical Working Group to develop the PMP/AB and associated tools and mechanism; (viii) recognized the importance of developing assessment tools on aquaculture health economics (aligned with the Global Burden of Animal Diseases) and emergency preparedness; and (ix) recommended improving the PMP/AB communication streams.

An essential step, as requested by COFI-SCA, is the formation of a FAO Technical Working Group that will provide guidance in the further development (including associated PMP/AB tools) and its implementation. Awareness-raising and consensus building on the PMP/AB will be a continuous activity. The development of the abovementioned multi-donor assisted long-term component on aquaculture biosecurity will also commence this year.

SEE ALSO

www.fao.org/fishery/nems/41063/en
www.fao.org/north-america/news/detail/en/c/1203328/
www.fao.org/3/na265en/na265en.pdf

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FAO Supports U.S. Congressional Briefings on Blue Growth, Aquaculture Biosecurity and Antimicrobial Resistance

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Clockwise: June 2017 U.S. Congressional briefing on Blue Growth: The Future of Fish as a Food Source; 2019 U.S. Congressional briefing on AMR in aquaculture with Senator Wicker of Mississippi State; debriefing (June 2017) with FAOLOW and MSU officials and the FIAA officer

In recent years, the FAO Liaison Office for North America (FAOLOW) and the Aquaculture Branch (FIAA), in collaboration with Mississippi State University (MSU), have organized U.S. Congressional briefings on various aquaculture topics. In 2017, the topic was "Blue Growth: The Future of Fish as a Food Source", and in 2018, the topic was "Aquaculture Biosecurity". The latter event was carried out back-to-back with the FAO/MSU/World Bank Stakeholder Consultation on Progressive Management Pathway for Improving Aquaculture Biosecurity.

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This year (2019), an important topic was covered in this briefing – The Invisible Threat of Antimicrobial Resistance. Mississippi Senator Roger Wicker and the Representative of the 3rd District of Mississippi Michael Guest gave opening remarks highlighting the importance of aquaculture both in the United States and internationally and applauded the ongoing partnership between FAO and MSU, now spanning six years, in strengthening capacities to achieve better aquaculture systems globally.

In July 2019, the U.S. Congressional briefing set the scene regarding the growing global threat of antimicrobial resistance (AMR) in the context of aquaculture, its multifaceted negative effects on the economy, food safety, trade, public health and the environment. Dr Mark Lawrence, Director of the Feed the Future Innovation Lab for Fish, hosted by MSU, highlighted that fish is the most traded food commodity in international trade and emphasized the importance of building capacity for fish health management internationally, which will protect the global industry and the United States alike. Mr Omar Elhassan, formerly of FIAA, emphasized the vital role the aquatic medium plays in the environment and the capacity for AMR to spread far and wide. Dr Richard Arthur, aquatic animal health expert from Canada,

focused attention on trade and rejections of fishery products due to levels of antibiotic residues that pose a risk to human health. Dr Larry Hanson, professor at MSU, stressed the vitally important fact that prevention is better than cure and that the best way to provide healthy, nutritious, high-quality products from aquaculture is through sound management and good biosecurity. Drs Patricia Gaunt, MSU Associate Professor, and Hao Bin, FIAA, provided country-level experiences of the United States and China, respectively, in tackling and mitigating AMR in the aquaculture sector. The five panelists then answered questions from the audience, comprised of 40 attendees from academia, government and the private sector.

Mr Vimlendra Sharan, Director of FAOLOW, closed the Congressional briefing by highlighting the multisectoral and holistic approach required for combating AMR and the collaborative, collective actions being taken by FAO, the World Health Organization, and the World Organisation for Animal Health. Special note was given to the new AMR Multi-Partnership Trust Fund, launched in June 2019, with an initial contribution of USD 5 million from the Government of the Netherlands.

Attendees to the U.S. Congressional briefings were from both the House of Representatives and the Senate, as well as other aquaculture stakeholders based in Washington, DC, and nearby states.

The Congressional briefings raised awareness and increased understanding of the various issues challenging the aquaculture sector in terms of its sustainability as a food source and the threats posed by biosecurity and AMR. They also stressed the need for global cooperation in mitigating its negative effects. Continued engagement activities such as these Congressional briefings are necessary to strengthen and foster the sense of shared responsibility among various stakeholders.

The next planned U.S. Congressional briefing will be in 2020 on the topic "Response Actions to Aquatic Animal Disease Emergencies". The findings of the round-table discussions on the same topic held in Rome in December 2019 will be presented.

SEE ALSO

www.fao.org/north-america/news/detail/en/c/1203328/

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Seaweed culture (laver, *Ulva* sp.), China

Focus sur le volet aquaculture continentale de la cinquième édition des Journées Maghrébines de l'Aquaculture

Focusing on Freshwater Aquaculture Sector at the Fifth Edition of the Maghreb Aquaculture Days

The fifth edition of the Maghreb Aquaculture Days was held in Ifrane, Morocco 2 to 4 July 2019 with the title "Freshwater aquaculture: status and perspectives". This event is organized by the FAO sub regional office for North Africa with the aims of strengthening collaboration and technical capacity of countries of the sub region in the field of aquaculture. A total of 41 participants took part in this event, including representatives of the countries of the sub-region (Algeria, Mauritania, Morocco and Tunisia with the exception of Libya), a representative of the Arab Maghreb Union, technical officers and consultants of FAO, as well as invited national and international experts. The main recommendations from the working groups and the plenary discussions concerned the support of the capacity development of investors / farmers through practical training sessions and exchanges / field visits between the countries; promoting and increasing intra-regional trade and cooperation between North African countries. This cooperation will be implemented through the establishment of a sub-regional network dedicated to the development of freshwater aquaculture under the aegis of the Arab Maghreb Union.

La cinquième édition des Journées Maghrébines de l'Aquaculture s'est tenue à Ifrane (Maroc), du 02 au 04 Juillet 2019 sur le thème "Aquaculture continentale: situation et perspectives". Ces journées sont organisées par le bureau sous-régional de la FAO pour l'Afrique du Nord dans le cadre de son programme régulier, en vue de renforcer les capacités des pays de la sous-région en matière de développement de l'aquaculture durable. Au total, 41 participants ont participé à cet événement, dont les représentants des pays de la sous-région (l'Algérie, la Mauritanie, le Maroc et la Tunisie), une représentante de l'Union du Maghreb Arabe (UMA), les fonctionnaires et consultants de la FAO ainsi que les conférenciers nationaux et internationaux invités.

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Photo de groupe des participants à l'atelier d'Ifrane, Maroc
Group photo of participants at the Ifrane workshop, Morocco

Le programme des journées comprenait 21 communications réparties dans les quatre sessions plénières suivantes : (i) contexte et état des lieux de l'aquaculture continentale dans la sous-région; (ii) systèmes de production en aquaculture continentale; (iii) gestion des risques sanitaires liés à l'aquaculture continentale et (iv) certification des produits aquacoles et promotion des échanges commerciaux. Il comprenait également une session de groupes de travail et une visite de terrain.

Cette édition a permis de discuter et identifier des nouvelles opportunités pour le développement de l'aquaculture continentale dans les pays de la sous-région en se référant aux systèmes d'élevage aquacole conçus pour une meilleure utilisation des ressources, à l'instar des systèmes intégrés et systèmes à circuit fermé qui prennent en considération la préservation de l'environnement et l'utilisation rationnelle des

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ressources en eau. Les journées ont également souligné les contributions potentielles de l'aquaculture continentale à la sécurité alimentaire et à la nutrition à l'échelle du Maghreb et la nécessité d'apporter un soutien aux petits producteurs des zones rurales de la sous-région. Les journées ont reconnu l'importance croissante du développement d'une aquaculture continentale durable et ont souligné la nécessité d'identifier et promouvoir des pratiques aquacoles optimales en vue d'atteindre cet objectif.

En outre, les pays ont recommandé que la FAO contribue à faciliter l'échange de données et d'expertises, indispensable au développement de l'aquaculture continentale, entre les pays du Maghreb, en s'appuyant sur les réseaux existants et/ ou en cours de formation et à fournir de l'appui dans les domaines de renforcement des capacités et de l'assistance technique.

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Visite de la station piscicole de Ras El Ma, Maroc
Field visit at the aquaculture station of Ras El Ma, Morocco

Les principales recommandations issues des groupes de travail et des discussions en sessions plénières ont concerné l'appui à la formation professionnelle des investisseurs/aquaculteurs à travers des sessions de formation pratiques et des échanges/visites entre les pays ; la promotion et l'amélioration des échanges commerciaux intra-régionaux et de la coopération entre les pays de l'Afrique du Nord. Cette coopération sera mise en œuvre à travers l'établissement d'un réseau sous-régional dédié au développement de l'aquaculture continentale sous l'égide de l'Union du Maghreb Arabe.

SEE ALSO

FAO 2018 - *FAN* 58 (April) - Fourth edition of the sub-regional workshop on aquaculture in the North African countries.
www.fao.org/3/i9200en/I9200EN.pdf

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Bassin utilisé pour la reproduction du tilapia du Nil (*Oreochromis niloticus*) dans une ferme qui utilise l'eau d'aquaculture pour irriguer les terres agricoles comme une pratique intégrée, Égypte.
Basin used for breeding Nile tilapia (*Oreochromis niloticus*) on a farm that uses aquaculture water to irrigate agriculture lands as an integrated practice, Egypt

Updates on Meetings Related to Aquatic Genetic Resources

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Expert workshop on The Development of a Global Information System for Farmed Types of Aquatic Genetic Resources

Expert Workshop on The Development of a Global Information System for Farmed Types of Aquatic Genetic Resources

In July 2019, FAO held an expert workshop on The Development of a Global Information System for Farmed Types of Aquatic Genetic Resources. The workshop was the first, critical step in designing a registry to collect information on aquatic genetic resources at the level below the species, namely, on farmed types (see pages 40-42 of this issue). Development of the registry is occurring under a project funded by the German Government. Under this project, a prototype of the registry will be released at the end of 2020 and will represent the core component of a future global information system that will collect and make available data from countries on their farmed types and stocks to facilitate monitoring of the global status of management of these resources.

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The experts worked to:

- identify country stakeholders who will benefit from the information system;
- determine an initial group of key species that will be the focus of the prototype registry;
- define the general structure of the registry and the future information system; and
- develop a nomenclature of farmed types, including criteria for their identification.

The classification of farmed types produced by the experts has been a major output of the workshop and will help to address the critical lack of standardized nomenclature and terminology for describing aquatic genetic resources.

Third Session of the Committee on Fisheries Advisory Working Group on Aquatic Genetic Resources and Technologies

In August 2019, in Rome, Italy, the ten members of the FAO Committee on Fisheries (COFI) Advisory Working Group on Aquatic Genetic Resources and Technologies (Working Group) convened for its third regular meeting.

Priority areas of discussion were follow-up activities to the Report on *The State of the World's Aquatic Genetic Resources for Food and Agriculture* (the Report), particularly the development of a Global Plan of Action (GPA) for aquatic genetic resources (AqGR) and the development of an information system to collect data on farmed types of AqGR.

In response to the call of the Commission on Genetic Resources for Food and Agriculture, FAO was requested to develop a GPA for AqGR and to consult also with COFI and its relevant subsidiary bodies on this important task. The Working Group agreed on the objectives and priority areas of the GPA, emphasizing that the GPA represents an opportunity to promote the development of AqGR through genetic improvement, an area where aquaculture still falls short in contrast to terrestrial food production sectors.

The Working Group reviewed and broadly supported the recommendations of the expert workshop on The Development of a Global Information System for Farmed Types of Aquatic Genetic Resources (see previous article) and recognized that this

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Third Session of the Committee on Fisheries Advisory Working Group on Aquatic Genetic Resources and Technologies

information system will constitute an essential component for the implementation of the future GPA.

The meeting was also an opportunity to discuss FAO's draft strategic plan to strengthen its key role in facilitating and promoting the conservation, sustainable use and development of AqGR worldwide. Among the priority actions identified within the draft strategic plan were proactive communication of the key findings of the Report, preparation of a set of guidelines for AqGR management and the promotion of a standard terminology for describing AqGR.

Information on the advisory role of the Working Group and on its members is available at **www.fao.org/aquatic-genetic-resources/activities/awg/en**.

COFI Sub-Committee on Aquaculture: Side Event on The Critical Role of Aquatic Genetic Resources in Aquaculture Development

Emphasizing the importance of aquatic genetic resources to the development of sustainable aquaculture, this side event was held during the Tenth Session of the COFI Sub-Committee on Aquaculture in Trondheim, Norway, in August 2019. The event officially launched the Report of *The State of the World's Aquatic Genetic Resources for Food and Agriculture* (the Report), the first-ever report of its kind.

Experts from FAO, WorldFish, the Indian Council of Agricultural Research–National Bureau of Fish Genetic Resources (ICAR-NBFGR), and the State Secretary for the Norwegian Ministry of Trade, Industry and Fisheries formed the panel for this event. Key messages from the Report were presented by FAO, while scientists from ICAR-NBFGR and WorldFish shared their experiences with regard to some of the key messages. The necessity of characterizing aquatic genetic resources (AqGR) to support policy development and the importance of well-managed breeding programmes to boost aquaculture production were among these key messages. The value of networking of stakeholders was recognized as fundamental to challenges to sustainable management of AqGR in production and to conserve wild relative AqGR. A prerequisite for an effective utilization of AqGR is the appropriate and effective application of genetic technologies and information. Also recognized was the need for more young geneticists, especially in the field of quantitative genetics, to engage in current and future activities in developing countries.

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The official launch of *The State of the World's Aquatic Genetic Resources* during COFI Sub-Committee on Aquaculture

The Report and its *In Brief* summary are available online at **www.fao.org/aquatic-genetic-resources/home/en**.

Training by the International Council for the Exploration of the Sea on "Genetics in Support of Fisheries and Aquaculture Management"

17–19 September 2019, University of Algarve, Portugal

In September 2019, FAO participated in a three-day training course entitled Genetics in Support of Fisheries and Aquaculture Management, organized by the International Council for the Exploration of the Sea (ICES) at the Centre of Marine Sciences of the University of Algarve, Portugal. The course was aimed at illustrating, through lectures, practical case studies and group exercises, the broad spectrum of ways capture fisheries and aquaculture can be improved by incorporating genetics into baseline data, models and monitoring programmes. Areas of training and discussion included genomics for monitoring control, selective breeding in aquaculture, traceability, stock assessment and applications of environmental DNA analyses.

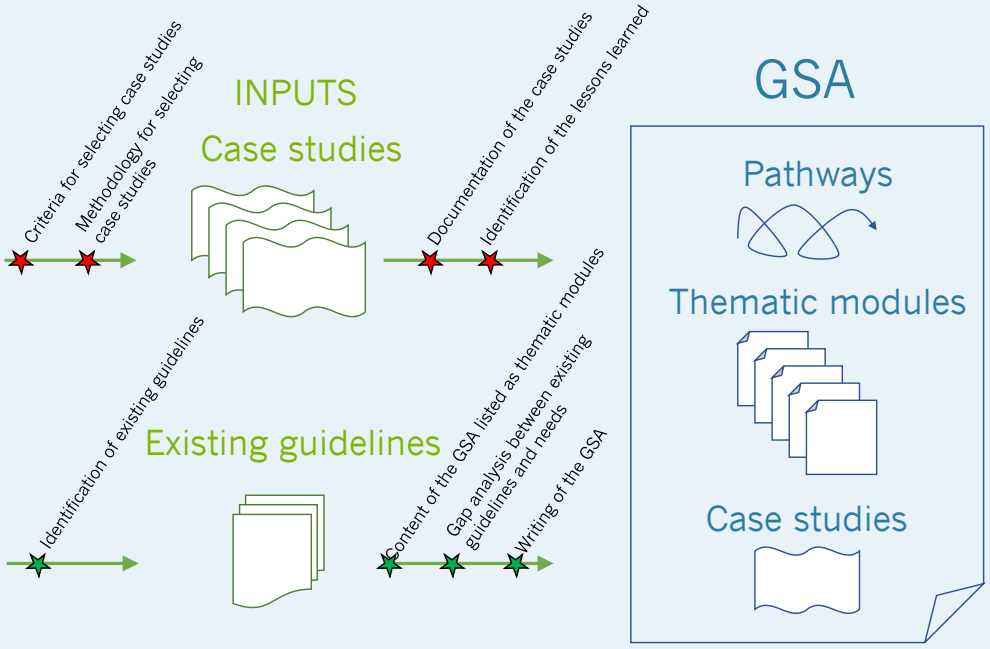
Modern genetic and genomic technologies can provide high-quality information at the species, population and individual levels, helping scientists and policy-makers to address essential issues on the management of aquatic genetic resources. The course stressed that the identification of clear questions and an adequate sampling design are essential for effective application of these technologies. However, in both capture fisheries and aquaculture management, some factors still prevent the use of genetics on a regular basis. Constraining factors included:

- lack of awareness of the full potential and possible benefits of genetic technology;
- lack of a communication strategy to build this awareness including to consumers; and
- the need for establishing long-term databases for genetic data.

FAO was invited to present its current work on aquatic genetic resources owing to its many synergies with the training topics.

Guidelines for Sustainable Aquaculture

FIGURE 1 – Steps in the development of the Guidelines for Sustainable Aquaculture



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As requested by its Members during the Ninth Session of the Committee on Fisheries Sub-Committee on Aquaculture (COFI-SCA), FAO is currently developing Guidelines for Sustainable Aquaculture (GSA - former acronym SAG) to provide practical guidance to government authorities and policy-makers in their efforts of promoting the implementation of the Code of Conduct for Responsible Fisheries (CCRF) and engaging and enabling aquaculture to effectively participate in the implementation of the 2030 Agenda for Sustainable Development. Other target beneficiaries will also include farmers, producer organizations, value-chain stakeholders, civil society organizations (environment, social), consumers, financing institutions and investors. For this, a series of successful and unsuccessful aquaculture case studies will be analyzed and their valuable lessons extracted.

A roadmap and methodology for developing the GSA proposed by an Expert Consultation, held in Rome in June 2019, was submitted to the Sub-Committee on Aquaculture at its Tenth Session in Trondheim, Norway, in August 2019 during a Special Event on Better Management Practices and Guidelines for Sustainable Aquaculture Development. Specifically, the Sub-Committee was invited to:

i) reflect on the process towards the development and implementation of GSA
ii) advise on the methodology for identifying the lessons learned from strategies and experiences of aquaculture developments worldwide by making use of the answers to the biennial CCRF survey (while considering the confidentiality of the answers to the CCRF survey);
iii) provide recommendations on how to make the CCRF survey questionnaire more relevant for reporting the implementation of GSA and Sustainable Development Goals;
iv) support resource mobilization efforts to raise awareness on GSA and strengthen related programmes.

The special event was also an opportunity for regional experts

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to present the work in their respective regions, as well as their views and perspectives towards the regional work for the guidelines on sustainable aquaculture. In the Latin America and Caribbean Region, it was pointed out that leading countries within the region possess experience with the issues presented. For example, Colombia is a leader in public policy development for tilapia production. The presentation from the African–Union Interafrican Bureau for Animal Resources brought to attention the greater intensification and expansion of pond, tank and cage production systems in the region and promotion of ecosystem health and integrity as best practices for sound business, including biodiversity, biosecurity, one health, climate-change resilience, early warning and equitable socio-economic development. From the European Inland Fisheries and Aquaculture Advisory Commission presentation, two case studies were proposed: (i) European Maritime and Fisheries Fund subsidies for the conservation and sustainable intensification of pond aquaculture; and (ii) legislation concerning feed and therefore nutrient discharge for trout aquaculture in Denmark. The Network of Aquaculture Centres in Asia-Pacific (NACA) highlighted the advanced use of integrated multi-trophic aquaculture (IMTA) in Asia and proposed it as a case study due to its use as a bioremediation approach against excessive nutrients. A second case study could be the coastal ocean longline and raft IMTA, since the region produces oyster/scallop and kelp as well as abalone, seaweed and sea cucumber. Marine ranching was also noted as a possible case study. Along these lines, a number of other opportunities that could be used as good case studies in the region were suggested, each of which will need to be evaluated during a regional GSA consultation.

FAO Members provided some suggestions on various topics such as: fish health and fish farming practices and the Norwegian experience with its close cooperation between the authorities, academia and the private sector in the development; Senegal called for more cooperation among African countries in order to allow for growth of aquaculture in Africa; and several case studies were also proposed on Mexican or Brazilian shrimp. Guinea highlighted its industry, which is based on the principles of agroecology and IMTA, and proposed that FAO complete a case study on this topic. Kenya asked to target regional policies and strategies that call for empowerment of women and youth in the aquaculture sector as possible case studies. The European Union highlighted the importance it gives through its funding mechanism of several projects that address different aspects of the sustainability of the sector. Morocco emphasized that it can be a good case study for other countries looking to develop marine aquaculture, as it has set up a specific legal framework for marine aquaculture, the result of an analysis of the legal approaches other countries.

Overall, the Sub-Committee on Aquaculture indicated its strong support of the proposal to convene regional consultations. It also stressed the need to ensure that all regions are part of the consultations; the importance of defining what guidelines for sustainable aquaculture are; and the importance of bringing onboard existing guidelines, specifically in the African region, where some guidelines have already been developed.

The GSA will build on lessons learned. The proposed methodology (Figure 1) is to use case studies and existing guidelines to develop the GSA, which will include pathways, practical thematic modules (including existing guidelines) and case studies. The list of thematic modules was developed by the experts, and a gaps analysis has been completed on thematic areas needing additional guidance. The expert consultation strongly recommended that the timeline be accelerated.

The following steps and tentative deadlines are the following: (i) regional meetings to be held, for example, in Africa, Asia, Latin America and Small Island Developing States and drafting of the GSA (2019–2021); (ii) the 34th session of the Committee on Fisheries (COFI) is informed of the GSA process (July 2020); (iii) GSA is submitted to the 11th session of the COFI Sub-Committee on Aquaculture in Mexico for review and adoption (2021); (iv) GSA is submitted to COFI 35 for endorsement (2022); (v) publication of GSA (2022/2023); and (vi) implementation, such as capacity building (from 2022/2023 onward).

SEE ALSO

COFI Sub-Committee on Aquaculture: **www.fao.org/cofi/aq/en**

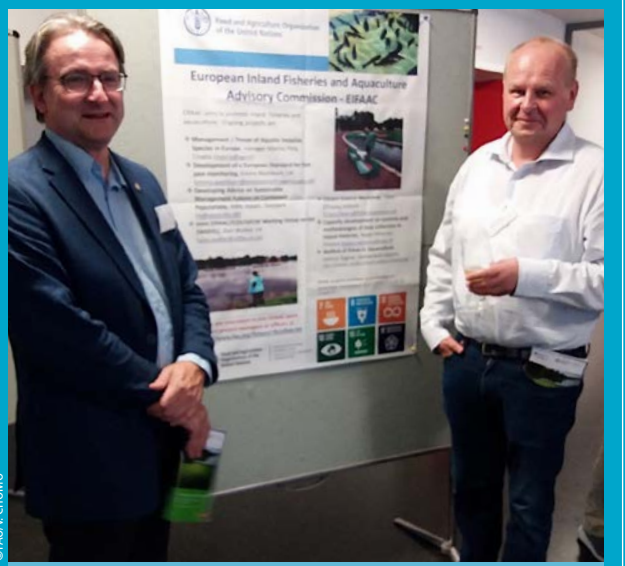
FAO Technical Guidelines for Responsible Fisheries available in support to Sustainable Aquaculture Development: **www.fao.org/fishery/publications/technical-guidelines/en**

European Inland Fisheries and Aquaculture Advisory Commission: Report from the Thirtieth Session and International Symposium

Fish from inland rivers and lakes, including freshwater aquaculture, has the potential to make significant contributions to healthy diets and sustainable food supplies in Europe. This was the main message of two important meetings of FAO's European Inland Fisheries and Aquaculture Advisory Commission (EIFAAC), which held its 30th Session in Dresden, Germany, 9–13 September 2019, in conjunction with an international symposium on food safety, certification, diadromous fish and conservation conflicts.

A main outcome of the session was a new communication strategy to better disseminate research findings and improve communication with regional policy-makers. The EIFAAC Symposium, for the first time, included the post-harvest topics of food safety and certification. Some recommendations formulated by participants were the following:

- Need to collate knowledge on inland fish species for effective, efficient and environmentally sustainable production while adhering to food safety standards equivalent to food safety programmes for marine species.



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Petri Heinimaa and Teppo Vehanen, Chairs of the EIFAAC and the Technical and Scientific Committee

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30th Session of EIFAAC, 11-13 September 2019, Dresden, Germany

- Identify deviations between risk assessment and risk management approaches in food safety for freshwater fish and fisheries products.
- Adopt surveys among anglers and other inland waterbody stakeholders that are standardized on a European level to allow data comparisons. Angler surveys could include social and economic queries to support evidence-based management decisions.
- Better coordination in the assessment of fish stocks between marine and inland waters, namely diadromous species. Where these result in management and conservation programmes, they need to be coordinated in a comprehensive way.

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Petri Heinimaa, Chair of 30th Session and Victoria Chomo, General Secretary of EIFAAC

SEE ALSO

EIFAAC website: **www.fao.org/fishery/rfb/eifaac/en**

Regional Workshop on Integrated Agri-Aquaculture in Desert and Arid Lands

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Group photo of participants at the regional workshop in Cairo

The workshop held in Cairo, Egypt, on 25–26 June 2019, was organized at the end of the project entitled "Integrated agri-aquaculture in desert and arid lands: learning from case studies from Algeria, Egypt and Oman", which was supported by the FAO Regional Initiative on Water Scarcity and the FAO Global Knowledge Product on water. The objective of the project was to build broad partnerships to support greater understanding in implementation and use of non-conventional water resources in integrated agriculture-aquaculture (IAA) systems.

The workshop was attended by representatives from Algeria, Egypt, Jordan, Lebanon, Mauritania, Morocco, Oman, Palestine, Saudi Arabia and Sudan, particularly individuals from research institutions and relevant national ministries. The primary objectives of the regional workshop were to share project outcomes with participants and to develop a provisional road map framework to serve as a guide for public institutions and the private sector in the use of non-conventional water resources for the promotion and sustainable development of integrated agriculture-aquaculture in desert and arid lands.

The workshop identified a number of priorities to enhance regional cooperation and to strengthen the development of the subsector, summarized as follows:

- develop demonstration IAA units/models using the best environmentally friendly technology (encompassing smart use of water and natural resources);
- develop demonstration IAA units/models based on the use of rainwater resources in Darfur as a model for Sudan. Noting that Sudan is characterized by limited water resources, extremely difficult environmental conditions and the presence of many refugees;
- elaborate information to promote IAA farming systems (including best management practices, practical manuals, labelling and marketing of IAA products, role of non-governmental organizations, awareness campaign on IAA, and establishment of small-scale farmer associations for marketing of products);
- establish a network of centres of excellence on IAA in the Near East and North Africa region in order to provide *ad hoc* trainings and technical assistance;
- develop financial and economic programmes to launch IAA projects in the region, aiming to gain financial and technical support from the FAO Water Scarcity Initiative, among others.

The project report, under preparation, will be published in the FAO Fisheries and Aquaculture Circular publication series.

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SEE ALSO

FAO Water Scarcity Initiative:
www.fao.org/neareast/perspectives/water-scarcity/en

Every drop counts: **www.fao.org/fao-stories/article/en/c/1111580**

Sharing innovative, water-saving agri-aquaculture experiences across the Near East and North Africa: **http://www.fao.org/blogs/blue-growth-blog**

Report on the FAO Regional Workshop on Pond Aquaculture for the West Balkans and Caucasus Region

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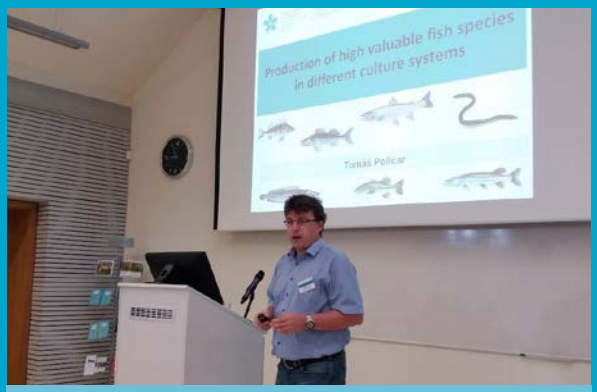
Practical demonstration of milking eggs from live African catfish

Under growing pressure from environmental changes and human activities, some inland fish habitats in Europe are degraded, stocks depleted, and some traditional and locally adapted farmed types are close to disappearing. Pond aquaculture offers sustainable and low-cost solutions that can reconcile interests of fish farmers, tourism and the recreational sector. Increasing pond aquaculture in Europe and the Caucasus offers a way to restock native fish species that may be preferred by sport fishers and local consumers. The FAO Regional Office for Europe and Central Asia, jointly with the Ministry of Agriculture of the Czech Republic, organized a regional workshop on pond aquaculture at the Faculty of Fisheries and Protection of Waters, University of South Bohemia (USB), from 30 September to 4 October 2019. Numerous faculty members and graduate students from the university provided technical and practical training during the five-day workshop on such topics as artificial reproduction, fish genetics and breeding, production and feeding, and conservation of aquatic genetic resources. There were 22 participants from several countries: Albania, Armenia, Bosnia and Herzegovina, Hungary, Montenegro, North Macedonia, Serbia, Turkey, Ukraine and Viet Nam.

Highlights of the workshop were:

- Scientific aspects of fish breeding and rearing and hands-on exercise for freshwater aquaculture of Europe.
- Hands-on exercise in milking eggs from live African catfish.
- Ornamental fish rearing and market information, with a visit to the top ornamental producer in Czechia.
- Tour of carp pond farms in the south Bohemia region. Czech carp farming began in the 15th century, with most of the existing ponds established at that time. These ponds are large reservoirs constructed in the Middle Ages without the benefit of modern extraction equipment. Czech farmers rear carp using extensive methods, i.e. without feed or with only locally produced cereals.
- The Ministry of Agriculture provided participants with posters of species important for Europe and books produced by the USB faculty on "applied hydrobiology", "crayfish biology and culture" and "fisheries in open waters".

This FAO workshop was a good example of triangular cooperation in providing the best scientific knowledge from Western Europe on freshwater fish production to improve aquaculture production in the West Balkans and Caucasus region.



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Theoretical lectures at Faculty of Water Protection, Vodnany, Czech Republic

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Workshop participant with a farm-raised sturgeon

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AQUACULTURE UPDATES BY REGION

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FAO support within Aquaculture Development in Pakistan

In the 1980s, the Pakistan Government placed high importance on aquaculture development. In consequence, the country experienced strong development of inland aquaculture, particularly carp culture; however, since the 1990s, aquaculture has become marginalized. In 2017, for instance, total aquaculture production was only around 160 000 tonnes, a share representing only 0.14 percent of world aquaculture production, falling far short of its 2.6 percent of world population. Low aquaculture production is among the reasons that the per capita fish consumption in Pakistan is about 10 percent of the world average. Compared to the world average of over 20 kg per year in 2019, fish consumption in the country remains the lowest in the world with only 1.9 kg per capita per year.

Pakistan has extensive resources of fresh and brackish water, and favourable agro-climatic conditions. However, multiple inefficiencies and constraints in the fish value chain are seen as blocking issues for aquaculture development. Three main constraints are: (i) unsatisfactory sanitary conditions in post-harvest handling and distribution; (ii) low and seasonal domestic fish consumption; and (iii) high production costs and a lack of economies of scale for existing fish farms.

Encouraged by more successful aquaculture development in neighbouring countries (e.g. Bangladesh, India and Iran, Islamic Republic of), existing and potential farmers in Pakistan are eager to venture into aquaculture. However, these farmers are deterred by a lack of success stories, especially in subsectors (e.g. shrimp farming) that have yet to take off despite various efforts in the past. The Government of Pakistan has recently reaffirmed the importance of developing aquaculture in the country, evidenced by explicitly including aquaculture development

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Carp and tilapia farm hatchery in Punjab, Pakistan

in the newly approved national food security emergency programme.

FAO has been actively supporting Pakistan to unleash its growth potential in aquaculture. Efforts include three missions under the FAO/World Bank Cooperative Programme to backstop the formulation of a multimillion World Bank project on aquaculture development in Pakistan, including: (i) a scoping mission in March 2019 focusing on assessment of the status of aquaculture and fisheries in Sindh Province; (ii) a field mission in August 2019 to conduct the "assessment of market opportunities for an expanded Pakistani aquaculture sector", which includes an international market assessment of key aquaculture commodities (shrimp, tilapia and trout) to identify export market opportunities, and a value chain diagnosis of Pakistani aquaculture to identify potential public and private interventions and aquaculture growth potential in the country; and (iii) a field mission in Pakistan in October 2019 to develop economic and financial models to facilitate the formulation of the World Bank project.

Built on three aquaculture development projects initially developed by the National Fisheries Development Board and approved by the national government, the World Bank project will be focusing on three areas: (i) shrimp farming (including hatchery operations) in Punjab, Sindh and Balochistan, with a focus on export earnings; (ii) cage aquaculture nationwide, with a focus on optimal utilization of natural water resources (reservoirs, lakes and rivers) and increased domestic fish consumption; and (iii) trout farming in northern regions for domestic niche markets (e.g. tourist consumption) and local economic development. A work in progress, the project is expected to be operational in early 2020.

In parallel, and in order to start immediate support to the development of an aquaculture sector in Pakistan, FAO assisted the Fisheries Development Board in the formulation of two Technical Cooperation Programme (TCP) projects, which focus, respectively, on the development of a National Policy and Implementation Plan for the Fisheries and Aquaculture sector (TCP/PAK/3709-C6), and a feasibility study and piloting of the farming of shrimp, prawn and fish species in Punjab and Sindh Provinces (TCP/PAK/3710). The two projects have recently been approved.

The National Symposium on Fisheries and Aquaculture for Food and Livelihood in Pakistan was held on 8 October 2019 with the purposes of raising awareness of the potential sustainable contribution of aquaculture and fisheries to inclusive economic development in the country, and commencing a discussion on how to tackle the challenges to this goal. The National Symposium was jointly opened by the Federal Minister for National Food Security and Research and the FAO Representative in Pakistan. Officers from the FAO Regional Office for Asia and the Pacific and the Fisheries and Aquaculture Department provided the National Symposium with key technical inputs and facilitated all three technical sessions centred around: (i) global fisheries and marine capture fisheries; (ii) development of aquaculture in Pakistan; and (iii) FAO-Pakistan initiatives for fisheries development. The three sessions were followed by a robust discussion whereby participants, including provincial government counterparts and relevant stakeholders, put forward their suggestions and input. Key discussion points centred around the complex pathways between fisheries and aquaculture and food and nutrition security, including the environmental, economic, social and legal/governance dimensions.

Starting with an overview on fisheries and aquaculture for food security and livelihoods in Asian countries, relevant issues were covered, including the need to include fish as a key element in food security, in nutrition and livelihood strategies at the national level, and in wider development discussions and interventions. A key point raised was the presence of inequitable roles and contributions of various actors (fishing communities, smallholders and fishing companies, etc.) in a diverse and heterogeneous sector, and the need to close these inequitable gaps. Additionally, institutional capacities need to be strengthened to meet international standards for conservation of water and natural resources use for aquaculture development. Statistics on Pakistan's fish stocks show a declining trend, which may be a cause for concern.

Technical experts delivered presentations on global fisheries production and trade, covering Pakistan's contribution, status, challenges and the way forward for marine capture fisheries and international fisheries instruments. Particular focus was placed on the impact of the country's non-ratification of the Port State Measures Agreement. Overfishing of marine fisheries requires urgent attention, and the high costs undermining the sector's profitability need to be addressed. Furthermore, development of aquaculture must not come at the cost of undermining livelihoods in vulnerable, small-scale fishing communities. Developing aquaculture requires diversifying variety, addressing post-harvest losses, and improving quality controls and processing technologies to ensure both the safety of the products and human health.

Other topics included status and development trends of aquaculture in Asia, challenges in aquaculture development in Pakistan and corresponding government initiatives to boost the development of Pakistan's aquaculture sector.

The Government of Pakistan has launched a comprehensive 309 billion rupee "Agriculture Emergency Programme", under which three of its thirteen development projects would be executed in fisheries, namely, projects on incubating shrimp farming, cage culture for fish species, and trout culture in Khyber Pakhtunkhwa. The financial allocation for the three development projects on fisheries is 13 billion rupees.

A presentation on aquatic animal health management was delivered, focusing on preventive health care of aquatic animals, and the importance of maintaining a healthy environment to reduce the risk of disease outbreaks or production losses and promoting healthy production systems. A suggestion was made that utilizing the FAO Code of Conduct for Responsible Aquaculture and the Ecosystem Approach to Fisheries, would ensure protection of natural biodiversity and the environment.

A project inception workshop was conducted jointly by FAO-Pakistan and the Fisheries Development Board of Pakistan to launch the two TCP projects the next day. The inception workshop was attended by representatives from relevant national and provincial fisheries authorities and institutions participating in project implementation. The workshop introduced the objectives and result framework and planned activities of the two TCP projects to the key players in project implementation, also discussing project outputs and the scope and implementation arrangements of project activities. Not only did the participants show high interest, but also Punjab Province proposed to serve as a pilot moving forward. All participating provinces expressed their willingness to develop provincial fisheries and aquaculture policy and update the respective legislations in line with the federal policy on fisheries and aquaculture. Accordingly, a formal request has been received by the Government of Punjab for technical support to develop the provincial fisheries and aquaculture policy to meet its Sustainable Development Goals targets.

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Aijaz Ahmed Mahesar, Secretary, Livestock & Fisheries, Government of Sindh, addressing the symposium

While continuing support of the development of the World Bank project for aquaculture development in Pakistan, FAO will explore the possibility of providing more direct support to the future implementation of the project through a technical assistance component with the World Bank project. FAO will provide full technical support to the implementation of the two TCP projects in Pakistan. The immediate follow-up action will be to support the Fisheries Development Board in finalizing the implementation details for the two TCP projects in consultation with the provincial fisheries development authorities and stakeholders, particularly the scope of project activities and coordinating mechanism.

Major findings from these activities include wide buy-in and agreement on the importance of enabling the further development of aquaculture within the sustainable food systems approach, including the following:

- The need for improved legislation and development of fisheries and aquaculture policy at the federal and provincial levels.
- The need for the establishment of a statistical data collection system on fisheries to support informed policy-making.
- The need to strengthen fish handling and safety protocols and procedures.
- The need to inform and promote rural communities on the potential for aquaculture for livelihood development through export earnings.
- The need for awareness-raising on the role of fish in healthy diets, with an objective of raising the current low levels of fish consumption.

SEE ALSO

WAPI factsheet on aquaculture growth potential in Pakistan: **www.fao.org/3/ca5585en/ca5585en.pdf**

Top 10 species groups in global, regional and national aquaculture 2017 – supplementary materials to the WAPI factsheet on "Top 10 species groups in global, regional and national aquaculture 2017": **www.fao.org/3/ca5187en/ca5187en.pdf**

WAPI factsheet on international market potential for shrimp export from Pakistan: **www.fao.org/3/ca7625en/ca7625en.pdf**

WAPI factsheet on international market potential for tilapia export from Pakistan Pakistan: **www.fao.org/3/ca7626en/ca7626en.pdf**

WAPI factsheet on international market potential for trout export from Pakistan: **www.fao.org/3/ca7627en/ca7627en.pdf**

The International Symposium on Integrated Agro-Aquaculture Innovations and Social Impact: Rice-Fish Farming

FAO and Shanghai Ocean University organized the International Symposium on Integrated Agro-Aquaculture Innovations and Social Impact: Rice-Fish Farming from 13 to 17 October 2019 in Shanghai, China. Over 120 people participated in the event, hailing from more than ten countries, including China, France, Indonesia, Lao People's Democratic Republic, Myanmar, Nepal, the Philippines, Sri Lanka and Viet Nam, and international organizations such as WorldFish. This event continued a series of workshops on rice-fish systems, namely, the Special Session on Advancing Integrated Agriculture Aquaculture through Agroecology, held in Montpellier, France (25–29 August 2018),[1] and the International Promotion Programme Workshop on Social Impact of Rice-Fish Farming in Shanghai, China (4–8 December 2018).[2]

The symposium themes included the relevance of rice-fish systems to the agroecology movement, specifically in relation to the social dimension of rice-fish farming, such as improved nutrition and benefits to indigenous peoples. Regional reviews of rice-fish farming in Asia-Pacific and Africa and country case studies helped to illustrate the global picture, and specific topics covered policy, challenges, innovations and extension. Also highlighted were technological innovations in the thematic areas of site and species selection, farming models and business management practices. Participants discussed and exchanged experiences related to their respective development status and further investigated the trends and objectives of rice-fish farming worldwide.

What set this symposium apart from other, similar symposia was its focus on the social dimension of rice-fish farming. These social elements included the impacts of rice-fish on nutrition and public health, on gender equity and women's empowerment, on youth employment, and the importance of traditional rice-fish systems for indigenous peoples and cultural heritage. To provide participants with a more informed perspective of the importance of the social impact of rice-fish farming, a field trip

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Participants visit the GIAHS site on mulberry-fish system

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Participants to the International Symposium discuss the social impact of integrated agriculture aquaculture

was organized to Zhejiang Province to visit a Globally Important Agricultural Heritage System (GIAHS) site.[3] GIAHS sites are internationally recognized as outstanding landscapes of aesthetic beauty that combine agricultural biodiversity, resilient ecosystems and a valuable cultural heritage. Here, participants witnessed and interacted with farmers practicing traditional mulberry farming on fish-pond dykes, using the fertile pond mud to fertilize mulberries, and in turn using the crop residues as fish feed. A second site showed the integration of rice and soft-shell turtle culture.

The workshop identified several key conclusions and recommendations to advance rice-fish farming development:

- Raise awareness and understanding of rice and fish production systems and their potential contribution to the upscaling of agroecology initiatives.
- Support conducive policy and strategy to support rice-fish farming to address the lack of good understanding of the merits and essence of this unique farming system.
- Provide an enabling environment, especially with regard to land management policy and use of terraced, lowland rice farming areas.
- Increase understanding and engagement between key actors, especially technical extension officers, traditional practitioners, the community, and the possible involvement of enterprises.
- Document good stories and practices, which will help policy-makers and rice farmers to initiate, adopt and advance rice-fish farming.

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Rice-fish farming field

1. www.fao.org/3/CA2325EN/ca2325en.pdf
2. www.fao.org/3/ca5223en/CA5223EN.pdf
3. www.fao.org/giahs/giahsaroundtheworld/designated-sites/asia-and-the-pacific/huzhou-mulberry-dyke-fish-pond-system/detailed-information/en

The Third International Symposium on Offshore Aquaculture, Shanghai, China

The Third International Symposium on Offshore Aquaculture was organized by the Chinese Academy of Fishery Sciences and hosted by the East China Sea Fisheries Research Institute on 18–22 October 2019. The event was attended by 180 participants from 12 countries – Australia, Canada, Chile, China, Finland, Germany, Israel, Japan, Republic of Korea, Norway, Sierra Leone and the United States of America – as well as several international organizations.

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Participants of the International Symposium on Offshore Aquaculture

The symposium presented state-of-the-art research and industry related to offshore aquaculture, and exchanged and showcased the experiences of the participants. Furthermore, the symposium identified bottlenecks and challenges for further expansion. After the opening ceremony, the participants participated in keynote speeches, thematic presentations from invited experts and a field visit. A high-level dialogue session was also organized. Partnerships among governments, research institutes and the private sector were highly promoted during the symposium, using the example of the Blue Economy Cooperative Research Centre and the partnerships among Australia, China, Chile and Norway.

The symposium called for ongoing exchange and discussion on offshore aquaculture developments, including relevant innovative technologies, business models, opportunities and challenges, as well as opportunities for capacity building. There were requests for further collaboration and cooperation worldwide among key stakeholders to ensure the sustainable development of offshore aquaculture. Specific recommendations included the following:

- Enhance understanding of and investment in offshore aquaculture, a possible space for aquaculture to achieve its potential in the global food production sector.
- Accelerate applied research in equipment design, automated management and mechanization, and investigate the integration of other sectors operating in offshore areas (e.g. wind energy, oil and gas extraction, and marine shipping).
- Call for government support in policy development, licensing and permitting, and environmental monitoring and disaster relief.
- Continue sharing knowledge and experience of successful cases and stories of offshore aquaculture development, particularly those involving novel cage structures, species, aquaculture models and business operations.
- Encourage partnerships in research and cooperation towards the implementation of smart, green and sustainable offshore aquaculture.

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Panel discussion during International Symposium on Offshore Aquaculture

In recent years, offshore aquaculture has become a major issue for debate among various stakeholders, and has attracted significant attention from governments, non-governmental organizations, research institutes, the industrial sector and investment partners. China has provided an excellent platform for exchange by organizing this international symposium on offshore aquaculture, in the belief that open communication and exchange is essential for sustainable growth.

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Discussing offshore aquaculture with Prof. Wang Lumin (CAFS) at a farm producing large yellow croaker (*Larimichthys crocea*)

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The International Conference on Fishery Science and Innovation, Shanghai, China

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Participants of the International Conference on Fishery Science and Innovation

The International Conference on Fishery Science and Innovation was co-organized by the Chinese Academy of Fishery Sciences (CAFS), the Environmental Defense Fund (EDF) and FAO on 24–25 September 2019 in Shanghai, China. The event was attended by more than 180 participants from 10 countries, including Canada, China, Italy, Japan, Kenya, United Kingdom and the United States of America, and international organizations such as the International Union for Conservation of Nature.

The conference discussed and outlined strategies under three major themes: conservation of biodiversity through innovations in science and management; mitigation of impacts on biodiversity and recovery of lost ecosystem functions; and rebuilding of ecosystems and recovery of biodiversity.

During the opening ceremony, Professor Wang Xiaohu, President of CAFS, Dr Manuel Barange, Director of FIA/FAO, and Dr Douglas Rader, Chief Oceans Scientist of EDF, welcomed participants, opened the conference and made keynote speeches, respectively.

The symposium called for increased dialogue and exchange on "green fisheries" and sustainable aquaculture towards their enhancement, with an aim to harmonize objectives relating to food production and environment conservation. There are requests for further collaboration and cooperation towards these objectives, such as the following:

- Recognizing that the success of fishery and aquaculture depends on a strong environmental ethic – encapsulated in the concept of "ecological civilization" that is increasingly permeating policy and consciousness – which is grounded in the practical realities of providing livelihoods and ensuring food security.
- Recognizing the decades of experience from around the world in supporting fisheries reform efforts through sound science, economic pragmatism and novel partnerships.
- Recognizing that placing high value on technical proficiency and international experience can channel both into a country's fisheries management system, providing the collaborative mindset needed to help adapt lessons learned for the local context.
- Recognizing the importance of research and innovations for environmental policy transitions, notably in pollution management, carbon emissions, and agricultural production and environmental management practices.
- Recognizing new attitudes towards sustainability culminated in an incredibly ambitious fisheries reform agenda and new approaches for investing in science, capacity building and forging new partnerships.

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FAO Director Manuel Barange discussed with Prof. Wang Xiaohu (CAFS) on collaboration

The meeting provided an opportunity for FAO and CAFS to further discuss and expand their collaboration through a proposed Memorandum of Understanding, relating to topics such as genetic resources, fishing technology, aquaculture, biosecurity, economics and information, taking advantage of the Chinese experience in the transition towards science-based fishery and aquaculture governance.

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Fish Feed Development in Central Asia – Ongoing Project Initiative

This project stems from identified priority areas for fisheries and aquaculture development in the Central Asia region, as discussed and identified by the members of the Central Asian and Caucasus Regional Fisheries and Aquaculture Commission (CACFish) during the Fifth Session (Tashkent, Uzbekistan, 2016). One of these identified areas under the Second Regional Work Programme of CACFish was a request for the *provision of technical advice on fish feed manufacturing*. The identified need for improved fish feeding practices was reinforced by FAO aquaculture experts from headquarters, the Regional Office for Europe and Central Asia, and the Subregional Office for Central Asia. At the moment, the main aquafeed issues in Central Asia is the lack of formulated fish feed in the region, since imported feed is costly and thus does not allow for a reasonable market price for local consumers. Thus, importing formulated fish feed is not an affordable solution for smallholders in Central Asia. Specifically, it was noted that smallholder fish farmers in the project beneficiary countries – Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan – would benefit from assistance on feeding practices of aquaculture species with an aim to improve efficiency and increase overall fish production, at a price affordable for domestic consumers. In this regard, this ongoing Regional Technical Cooperation Programme project focuses on commonly farmed and consumed fish species to address the needs of smallholders and government extension agents in Central Asia for improved knowledge and materials for feeding fish. Among the topics covered are the possibility of using low-cost farm-made feeds or regionally sourced materials, raising farm productivity and maintaining affordable costs of production. Trout and carp were identified as having the most potential for improving livelihoods of smallholders in Central Asia and providing nutritious and affordable fish products in local markets.

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Improved feed and feeding practices are expected to increase efficiency and productivity in carp farming

This project is funded under the FAO Regional Initiative "Empowering Smallholders and Family Farms for Improved Rural Livelihoods and Poverty Reduction, and contributes to results under FAO's strategic framework. The project identified three main outputs in order to deliver its overarching objective: (i) assessment of current practices for fish feed in the Central Asia region; (ii) guidelines on good practices in fish feed for smallholders in Central Asia; and (iii) knowledge of smallholders increased on good practices for

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fish feed. Therefore, first the national surveys were developed so as to identify current practices of feeding carp and trout in the participating countries. During 2019, the next phase of the project consisted of farm visits to follow up on the surveys conducted under the first output. Follow-up activities will include a national workshop to validate the findings. Through inception workshops, engagement with relevant government officials and extension agents and on the ground work with farmers from each country, all stakeholders had the opportunity to discuss ideas on how to increase farm productivity and improve upon current practices. Field visits were carried out to representative small-scale fish farms to identify and document current feed practices while investigating opportunities for improvements. A questionnaire was used to collect more detailed information and will allow information from each country to prepare a case study that will facilitate comparison among countries and provide the opportunity to share lessons learned.

Using these initial findings, the content for a "Desk Study on Good Practices in Fish Feeding in Central Asia (Carp and Trout)" was identified, and the study will summarize the status of carp and trout production in Central and Eastern Europe with special regard to the general aquaculture development landscape in Central Asia, good practices and guidelines for improved feeding practices and feed supply for carp and trout culture, and will delineate some pathways towards additional support of smallholder aquaculture farms.

The country visits were productive in that firsthand evidence was gathered on fish feeding practices and feed mill availability in all three countries visited so far, as well as the general situation and structure of fish farming in those countries. The FAO technical team also met with relevant stakeholders in private sector and government offices. A more complete picture of the sector for each country visited should come through the structured questionnaire and will be part of country case studies of the final desk study presented.

SEE ALSO

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Carp pond in the Kyrgyz Republic

Strengthening Blue Communities in the Mediterranean

Diminishing production from capture fisheries in the Mediterranean is increasingly threatening livelihoods, food security, the economy and culture of fishing-dependent communities, a dire situation encompassing millions of people. These changes largely stem from years of unsustainable rates of exploitation, compounded by other anthropogenic stressors, including climate change. Reversing these trends through sustainable fisheries management is important, but just as vital is the task of finding ways to sustain and help grow these fishing-dependent communities.

FAO's Blue Hope project seeks to support such communities, specifically in Algeria, Tunisia and Turkey, by developing sustainable and inclusive multisectoral investment plans that help fishing communities diversify their livelihoods and economies and by identifying financing to facilitate such a transition.

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The FAO Blue Hope project delegates including government representatives, FAO representatives, fishers and community leaders

Algeria, Tunisia and Turkey are the top three employers in the fishing sector among Mediterranean and Black Sea countries, accounting for 40 percent of the jobs in the region, and all sharing rich cultures centred on the Mediterranean Sea. In turn, the direct fishing employments these countries provide support to hundreds of thousands of dependents and constitute the backbone of their respective coastal communities. With capture fisheries production stagnating, the need to look beyond capture fishing, to other sectors, for social and economic security has become increasingly important.

The approach to FAO's Blue Hope project is founded on two key premises, including that intersectoral action will help to reduce conflicts and maximize collective benefits and that investment planning can help bring stakeholders together to chart a vision for the future while facilitating the mobilization of public and private sector finance to help jumpstart that transition. To this end, and leveraging FAO's Blue Growth Initiative "theory

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Akyaka, Turkey, one of the Blue Hope project communities

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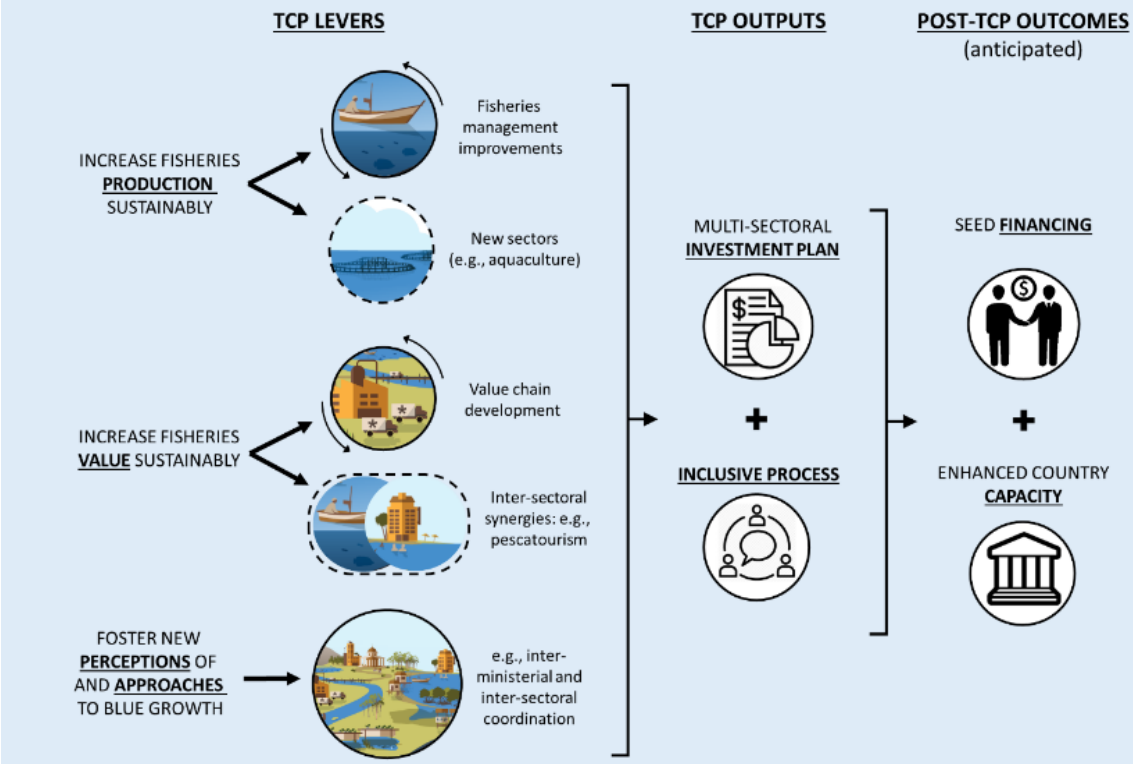
FIGURE 1 – The FAO Blue Hope TCP Logical Framework



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of change", the multisectoral investment plans are being developed by leveraging and integrating existing FAO tools and international instruments along four primary axes, as indicated in Figure 1.

The Blue Hope project is currently at its halfway point. To date, countries have identified priority areas for each strategic axis, and experts are being commissioned to explore and validate these priority areas. Next, bankable projects will be formulated. In Turkey, the project is exploring sea cucumber and grouper hatchery feasibility and profitability for stock enhancement. In Tunisia, interest lies in integrating tilapia farming with agriculture. In Algeria, experts are also exploring sea cucumber hatcheries for stock enhancement, while also looking to build fish feed plants by leveraging Turkish expertise in this domain. A visit by Turkish fish feed factory owners and staff to Algeria is planned for early 2020. Where appropriate, the project is also exploring possible synergies between the aquaculture and tourism sectors (such as on-site oyster tastings) to help fishing communities add value to and further diversify their livelihoods. While it remains to be determined, the project will also likely establish a number of pilot projects to test the feasibility and profitability of aquaculture project ideas.

While important work still needs to be carried out, the Blue Hope project is making progress in convening key stakeholders, including marginalized groups, women and youth, to develop investment plans that actually respond to community needs, in engaging potential public and private financial institutions, and in fostering interregional exchanges and collaboration.

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Suat Demirayak, owner and chef at Kordon Restaurant in Akyaka, Turkey prepares traditional fish dishes from the Gokova region

Clam and Oyster Culture in Djibouti

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Coastal village in Djibouti

Djibouti, on the eastern coast of the African continent, is not a particularly logical place to initiate aquaculture activities, either freshwater or marine, not least because of the small area of the country. The terrestrial part of Djibouti mainly consists of porous volcanic rock, which is not very conducive to pond aquaculture. Naturally, one could use fibreglass or concrete tanks, but water supply is also a serious constraint. The maritime area of the country is limited and is mainly reserved for transport, capture fisheries and naval activities. Cage culture to rear groupers has been attempted, but because costs were high and operations were not profitable, the activity was abandoned. Although development of mariculture in Djibouti is feasible, there are a number of constraints to its development, including the absence of fish feed manufacturing companies for fed aquaculture. The feed, however, could be imported to overcome that challenge.

The culture of non-fed target species such as clams, oysters or seaweed could be interesting alternatives to fish and crustaceans. This was the idea when a Technical Cooperation Programme intervention was proposed by the Fisheries Department in Djibouti, which started in March 2017 and ended in 2019. Clams and oysters occur naturally in Djiboutian waters; thus, in theory, aquaculture could be just a matter of collecting juveniles and placing them in special culture beds. Accordingly, the project recruited an international consultant with much experience in rearing clams and oysters in Europe, Mr Frédéric Paillère. He conducted a number of fact-finding missions to Djibouti, first to conduct a reconnaissance study to find out where clams and oysters could

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Community members showing a juvenile clam from the aquaculture plot

be found naturally; second, to determine if it was possible to grow them under controlled conditions; and third, to train youth groups to manage these culture beds through providing selected youth cooperatives with all the tools necessary to grow, harvest and process clams and oysters.

After the fact-finding mission identified a number of accessible sites where juvenile clams of the species *Ruditapes decussatus* could be found, these sites became the source for clam collection by young men and women.

Youth cooperatives seeded juvenile clams on clean sandy stretches in the intertidal zones in 10 × 2 m "plots" at a density of 200/m^2. The plots were surrounded by fine meshed cloth of 60 cm width that was placed in the sand down to a depth of 30 cm with a further 30 cm extending above the sand. Metallic bars that were placed at approximately 1 m distance from each other supported the mesh.

The Fishermen's Cooperative of Obock was instrumental in guiding the youth during the absence of the consultant, and the growth of clams was regularly checked. The youth were paid by the cooperative for clam collection assuming that one day the cooperative could market the harvest. The first production cycle was dramatically perturbed by bad weather, with high waves rolling onto the beach, destroying the clam beds. The tidal waves did not discourage the youngsters, who had to practically start again from scratch, which they did.

The Obock cooperative and the FAO Country Office signed a Letter of Agreement, which allowed the youth to bring some relevant materials, such as rakes and graders, from Europe to Djibouti, which considerably improved clam collection, sorting and seeding.

Apart from clams, the project was supposed to grow oysters as well. However, the few patches of mangroves contained only limited quantities of oysters on their roots, which were also of very small size, likely due to the lack of sufficient nutrients and feed in the water. On some rocky patches, the rock oyster, *Crassostrea cucullata*, was found but again only in small quantities.

An interesting mangrove forest in the northern part of the country, Godoria, ideally located in a lagoon, appeared to be the natural place for mangrove oysters *Dendostrea frons* and *Lopha cristagalli*. Small oysters were collected from the mangrove roots and placed in special pouches made of wire mesh, which were then suspended between the roots. Growth performance was not spectacular, but the system worked.

On sandy patches between mangroves, clams were seeded and their plots marked. The lagoon seemed to be the right environment for the clams and oysters. It has been proposed to conduct trials with giant clams (*Tridacna* spp.) as well as with different species of seaweed.

The project duration was too short to conduct proper purging activities nor to effectively market the produce. A few mouthwatering tryouts had been organized to convince the fisheries authorities of the excellent taste and quality of the cooked clams from the pristine waters of Djibouti. Even H.E. Ismaël Omar Guelleh, the President of Djibouti, tried them and greatly appreciated the product as well as the efforts by the youth of Obock. Main drawbacks that the project faced were delays in recruiting the international consultant and the unfortunate bad weather event.

Culturing of unfed species such as bivalves and seaweeds has the potential in Djibouti to substantially increase nutritious food without negatively impacting the lagoon or ocean ecosystems. The ministry responsible for fisheries indicated it would continue the assistance to this new sector.

Members of the fishing cooperative transporting materials to the farming site

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Use of Social Media by Youth Fish-Farming Groups in Ghana

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Youth catfish farmers constructing feed store

Engaging youth in sustainable aquaculture value chains is the urgent and critically important objective of an ongoing project in West Africa. One activity, catfish culture integrated with vegetable gardening in Nigeria, was presented in the previous issue of *FAN*.[1] Interestingly, fish farmers in this country use the wastewater from the fish tanks to irrigate horticulture, with the fish excrement acting as plant fertilizer. The result is an additional harvest of tomatoes, beans and other vegetables, and more efficient use of water and resources, acting as an example of integrated aquaculture-agriculture.

A similar activity is being implemented in some Debiso enclaves in the Western North Region of Ghana, where FAO is supporting training of selected youth groups in a project funded by the Africa Solidarity Trust Fund (ASTF). Upon receiving the training, these groups went on to form registered associations consisting of at least 20 percent women. Various training sessions included fish-keeping and bookkeeping, thereby ensuring that good aquaculture practices were matched with appropriate business development.

The project required a contribution in-kind from the groups, for example, in digging the wells for water supply of the tanks; indeed, they performed this activity, which increased the sense of project ownership. In the Nigerian experience, the project used fish tanks made of fibre reinforced plastic, but these tanks were difficult to source in Ghana. Instead, the commonly available black water tanks, which can be found on roofs practically everywhere in many countries, were modified by one of the manufacturers into open fish tanks, with a special draining hole in the bottom. Large trucks distributed the water tanks throughout the remote Debiso enclaves, which proved a challenge, as the roads were barely accessible by truck. Locally recruited plumbers connected the tanks to water supply tanks, which were provided by the project. Catfish fingerlings were provided from a Ghanaian fish breeder, who was also a beneficiary of the same project, and, after some start-up difficulties, the tanks were stocked with fish.

Since remote communities had been selected for the project, regular monitoring became difficult. The project faced challenging questions, such as the following: Who was going to supervise the young fish farmers who had limited experience in keeping fish? How much feed should be used for an acceptable growth performance? What should they do in the event of unexpected fish diseases or mortality?

To help answer these questions, the project established a social media messaging group for the four communities. All the youth were familiar with social media, and each appointed "spokesperson" communicated regularly on the progress made with the fish rearing. For example, when a catfish was found with a skin disease, it was photographed and posted for the entire group as well as for the monitoring colleagues to see, discuss and advise. One picture almost went viral, as the head of a fish

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Ghanaian youth catfish farmers preparing access road to farm

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1. *Aquaculture integrated with horticulture takes northeast Nigeria by surprise. FAO Aquaculture Newsletter* No. 60. 2019. Available at **www.fao.org/documents/card/en/c/CA5223EN**.

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Catfish stocking in full swing

appeared to stick out of the belly of another fish.

Most importantly, the groups had been taught how to keep records of their findings, the average weights of fish samples, daily amounts of feed applied, and other measurements. Instead of typing up the information, a simple picture of a datasheet was sufficient to share the data among the others. Especially in the beginning, it was important to demonstrate growth in order to show that the method worked. The groups reported regularly, and made each other enthusiastic about their results.

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Youth catfish farmers at work on water reservoirs and biofilter

In a parallel Nigerian project, feed conversion ratio appeared quite high, definitely for a first production cycle by newly trained fish farmers; it was 1.1 kg of feed for 1 kg of fresh catfish. The ASTF youth employment creation project applied the same method in Western Ghana. There, the fish reached about 1 kg in weight in about five months. Admittedly, the starting size of the fish in Ghana was slightly larger than in Nigeria.

The youthful fish farmers also wear uniforms, promoting the project:

"FOR MORE FISH, CALL FAO FIRST"

which helped to develop a sense of camaraderie and importance surrounding the project.

In addition, a building is under construction, where several FAO Thiaroye Technology smoking kilns are located. Constructed close to the four communities for their common use, the processing center increases the value and conservation of the harvested fish.

Lessons learned

– Procuring live animals is not an easy task. The ASTF project suffered considerable fish mortality due to the standard FAO procurement rules and regulations. In another of the participating countries in the ASTF project, about 70 percent mortality occurred when fingerlings were subjected to high temperature on the tarmac while in transit by air.
– In Nigeria, there were heavy losses because, though the fingerlings were too small for safe transport, the timeline of the contract dictated premature shipment.
– In a follow-up project, more emphasis should be placed on solar pumps instead of petrol-driven pumps to increase environmental sustainability, encourage further technical skill development and reduce reliance on petrol supply.
– Instead of relying on information provided by the local villagers about the depth of the water table, it is better to conduct independent assessments to assure continuous water supply, which in this case resulted in the recommendation to sink boreholes to assure water supply throughout the year.
– The combination of aquaculture and agriculture is an attractive concept for youth farmers, especially in remote areas, with the added benefits of increased food availability and multiple revenue streams.

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Showing catfish to fellow catfish farmer groups

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Feeding catfish in a plastic tank

Updates for the Southern African Development Community and Southern Africa region

Since 2018, FAO and the Southern African Development Community (SADC) have developed and are implementing joint work plans in several areas promoting sustainable development, including in the aquaculture and fisheries sectors. Fish is the most affordable source of dietary animal protein and therefore of overwhelming importance for food and nutrition security within SADC.

"The livelihoods of fishing communities in the SADC region are among the most insecure and vulnerable in the region. The growing population of the region is dependent on its fisheries resources with an overall increasing tendency towards an over-exploited status of marine and inland fisheries resources. Lack of management actions have resulted in an increasing tendency of depletion of resources, but also in a tremendous waste of the value and income of these resources to this region. The consequences are most devastating for the poorest communities of the SADC region," said Alain Onibon, FAO Subregional Coordinator for Southern Africa.

In response, the SADC Ministers approved, in June 2019, Best Practices Guidelines for Aquaculture Management in the region, which were developed by the SADC Technical Committee on Fisheries. The tool, which addresses key environmental and social impacts issues common to all aquaculture activities, is vital for the development and management of the fisheries sector in the SADC. In addition to these best practices guidelines, another tool, the Protocol on Fisheries Implementation Monitoring Tool, was approved by the SADC Ministers to help member states monitor the implementation of the aforementioned protocol.[1] SADC members expect that these two tools, developed with the support of FAO, will reinforce and inform the implementation of their programmes in aquaculture and fisheries.

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SADC Members in Harare marking the start of implementation of monitoring tools for the SADC Protocol on Fisheries and SADC Best Practice Aquaculture Management Guidelines

A workshop was held in Harare, Zimbabwe, on 13 November 2019 which marked the start of the implementation of monitoring tools for the SADC Protocol on Fisheries and the Aquaculture Management Guidelines. The two tools will be used by member states to monitor progress and actions towards implementation of the regional Protocol on Fisheries, which covers several subsectors, including aquaculture, management and protection of the aquatic environment, human resources development, trade and investment, and science and technology.

The Permanent Secretary of the Ministry of Agriculture, Zimbabwe, Mr Ringson Chitsiko, said it was vital to have a monitoring system to detect needs and effectively implement the protocol, noting "Monitoring systems allow for harmonised methodology used by each individual state and analyse their own operation and performance and detect and alert possible errors".

SADC members expect the two tools will reinforce and inform better coordination and implementation of their programs in aquaculture and fisheries.

Support from development partners is important; however, these investments and planned actions that members are undertaking through their own means and participation in this process are vital in achieving a more sustainable management of the fisheries sectors.

These two tools are now effectively assisting the SADC Secretariat to comprehensively report back to its members on the status of implementation of the SADC Protocol on Fisheries, and also report on the status and needs of aquaculture management and development in the region. This, in turn, is enabling the development of better coordinated interventions, partnerships, and actions towards sustainable fisheries and aquaculture development in the region (both at the regional and national levels). An example is the German-funded project in which FAO and WorldFish supported SADC with the Platform for Genetics and Biodiversity Management in Aquaculture. This project was established partly with the aim of leading and developing a set of protocols to guide sustainable genetic improvement research and development programmes in the African region, particularly the SADC region, mainly with Malawi and Zambia. Together, FAO and other partners such as Germany, the African Centre of Excellence of Fisheries and Aquaculture, and Advance Africa are working with FAO in supporting SADC interventions for 2020 and beyond.

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1. **www.sadc.int/documents-publications/show/801**

What are "Farmed Types" in Aquaculture and why do they Matter?

FAO launched the first-ever Report on *The State of the World's Aquatic Genetic Resources for Food and Agriculture* (the Report) in August 2019. One of the principal findings of this report is that very little information is available on aquatic genetic resources (AqGR) used in aquaculture (or their wild relatives), below the level of the species. In this regard, the Report recommended to "establish and strengthen national and global characterization, monitoring and information systems for AqGR". The Report further concluded that there was a lack of standardization of terminology and nomenclature used to describe AqGR, which generates confusion and uncertainty. While identifying a clear need to standardize and harmonize this terminology, FAO presented and used standardized terminology throughout the Report. Subsequently, FAO, in August 2019, held an expert workshop on the development of a registry of farmed types of AqGR (see article on pages 18-19 of this issue). This registry will be the core component of a broader information system for AqGR to be developed in the near future.

The objective of this article is to present and explain the definitions of farmed types and identify the importance of using standardized definitions through a proposed information system for AqGR.

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Common carp (*Cyprinus carpio*) is one of the longest domesticated aquaculture species with a wide distribution and has a number of distinct strains. These examples are held at the live gene bank maintained at the Research Institute for Fisheries, Aquaculture and Irrigation (HAKI), Szarvas, Hungary

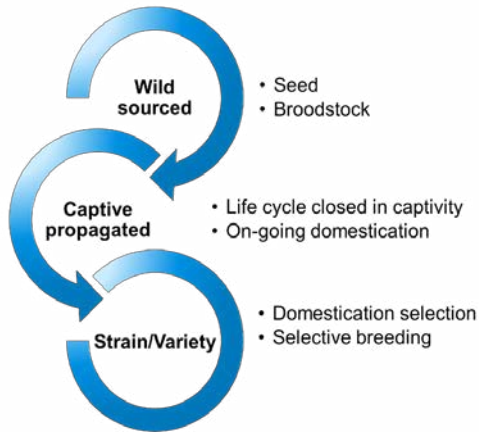
What is a "farmed type"?

The term was coined in a 2016 FAO workshop[1] as a descriptor

A "farmed type" refers to a farmed aquatic organism that could be a strain, variety, hybrid, triploid, monosex group, or other genetically altered form or wild type.

1. FAO. 2016. *Report of the expert workshop on incorporating genetic diversity and indicators into statistics and monitoring of farmed aquatic species and their wild relatives.* FAO Fisheries and Aquaculture Report No. 1173. Rome. (also available at **www.fao.org/3/a-i6373e.pdf**).

FIGURE 1
Illustration of the domestication continuum and the classification of three levels of associated farmed types



of farmed AqGR below the level of species. All aquatic organisms found in aquaculture should be defined by their species and by one or more farmed types. Subsequent to the identification of the specific farmed types by experts in the 2019 workshop, it was resolved to categorize these further into primary and secondary farmed types. Primary farmed types describe the status of domestication and improvement, typically through selective breeding as the core technology, along a domestication continuum. In addition, there is a range of genetic technologies that can be and are applied to "add value" to the domestication or selective breeding process. The results from the application of these value-adding technologies are the secondary farmed types. Examples of these secondary farmed types can be found in the main species groups used in aquaculture.

The domestication continuum – primary farmed types

Humans started to domesticate terrestrial animals and plants around 10 000 years ago, and most of our modern-day livestock and crops have been fully domesticated for over 5 000 years (Duarte, Marbá and Holmer, 2007).[2] Many are barely recognizable compared to their wild relatives. Domestication of aquatic species, with a few exceptions,[3,4] started only around a hundred years ago and most of our current aquaculture species were domesticated in the past few decades. As a result, most of our domesticated farmed types are largely indistinguishable from their wild relatives. One positive aspect of this recent domestication is that current farmed types can still retain much of the genetic variation present in wild stocks. Also, the Report confirms that wild relatives of all farmed species can still be found in nature, which is far from the case for many of our terrestrial agriculture species. The Report also showed that some of our cultured species are still harvested directly from the wild (either as wild collected seed or as offspring of wild caught broodstock). The expert workshop defined such farmed types as "wild sourced".

The life cycle of many cultured aquatic species has been closed in captivity, and the seed of these species can now be produced in hatcheries using broodstock that were themselves spawned in captivity. Some of these farmed types have developed and become genetically changed, either through genetic drift, domestication selection[5] or using deliberate selective breeding, to the point that they are clearly distinguishable from other farmed types of the same species (in a similar, but less extensive way, Friesian and Holstein breeds of cattle are distinguishable from each other). This distinctiveness permits these farmed types to be classed as strains (for animals) or varieties (for plants). Given the early stage of domestication and genetic improvement in aquaculture, the majority of farmed types for which the life cycle has been closed in captivity are not yet differentiated to the point where they can be considered as strains or varieties.

It is nevertheless important to record these farmed types if they make an important contribution to production. The expert workshop coined and defined the term "captive propagated" to describe these "transitional" farmed types that are no longer wild sourced but have not yet differentiated to the point that they can be described as strains or varieties. It is extremely useful to note that all aquacultured organisms can be allocated to one of the four primary farmed types (see Figure 1 and Table 1).

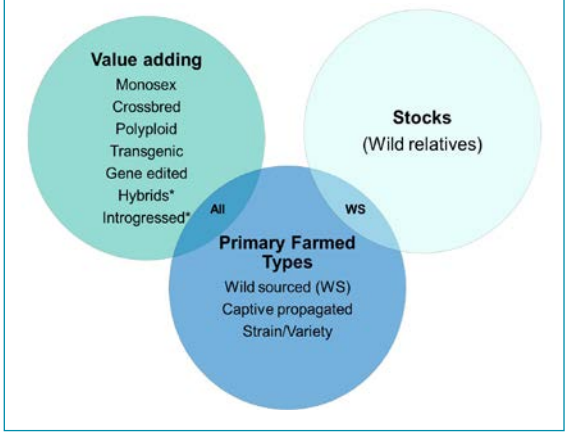
Secondary farmed types

There is a range of genetic technologies that can be applied to many aquatic organisms and that can be used to add value to a domestication or selective breeding programme. These technologies can be used to produce a range of secondary farmed types within the primary farmed types. These include the following:

- monosex generated by genetic manipulation of sex determination;
- hybrid (F1 crosses between species) and crossbred (crosses between primary farmed types within a species);
- introgressed – hybridization that goes beyond the initial F1 cross;
- polyploid, mostly commonly triploid – induced to produce sterile organisms; and

2. Duarte, C. M., Marbá, N., & Holmer, M. 2007. Rapid domestication of marine species. Science, 316(5823): 382-3.
3. Harland, J. 2019. The origins of aquaculture. Nature Ecology and Evolution, 3: 1378–9.
4. Teletchea, F. & Fontaine, P. 2014. Levels of domestication in fish: implications for the sustainable future of aquaculture. Fish and Fisheries, 15: 181–195.
5. The equivalent of "natural selection" in an artificial environment.

FIGURE 2
Diagram illustrating the relationship between primary and secondary farmed types and wild relative stocks



– genetically engineered farmed types resulting from transgenesis or gene editing.

Figure 2 illustrates that secondary farmed types can be produced from all primary farmed types.

Also, wild-sourced primary farmed types can be related to natural stocks of wild relatives.

What is the value of an information system on farmed types?

The development of an information system of farmed types will deliver a number of benefits to key stakeholders:

– promote utilization and understanding of standardized terminology;
– advance the development and harmonization of national and international information systems;
– facilitate recording of farmed types and their use and exchange;
– build a deeper understanding of the development and properties of each farmed type, the needs and opportunities associated with them, and their capacity to contribute to national aquaculture production;
– enable more informed policy development and decision-making regarding AqGR; and
– enable the collation of data and the development of indicators on the status and health of AqGR, including indicators for monitoring and reporting trends in relation to a future Global Plan of Action, conservation goals and Sustainable Development Goal target 2.5.

TABLE 1 – A list of primary and secondary farmed types including definitions and examples

FARMED TYPE	DEFINITION	EXAMPLES
	Primary farmed types	
Strain (animals)	A farmed type of aquatic species having relatively homogeneous appearance (phenotype), homogeneous behaviour, breeding history and/or other characteristics that distinguish it from other organisms of the same species in that country and that can be maintained by propagation	Selectively bred Pacific oysters with resistance to Pacific Oyster Mortality Syndrome caused by the virus OsHV-1 (oyster herpes virus)
Variety (plants)	A plant grouping, within a single botanical taxon of the lowest known rank, defined by the reproducible expression of its distinguishing and other genetic characteristics*	Registered cultivars of *Pyropia, Undaria* and *Saccharina* in the Republic of Korea
Captive propagated	A farmed type for which the life cycle has been closed in captivity (i.e. not wild sourced) at least for one generation and aquaculture seed is derived from broodstock that have been spawned and reared in captivity, but does not meet the criteria as a strain or variety	Hatchery-raised Indian major carp across many states of India having been domesticated since as early as the 1970s but not subjected to deliberate selective breeding
Wild sourced	A farmed type in which aquaculture seed or broodstock are sourced from wild stocks, i.e. have not been bred in captivity	Bluefin tuna in Australia and Japan, harvested from the wild and grown out in cages. *Penaeus monodon* produced from broodstock harvested from the wild
	Secondary farmed types	
Hybrid	The F1 progeny of a cross between two different species	F1 hybrid between female *Clarias microcephalus* and male *C. gariepinus* cultured in Thailand
Introgressed	A farmed type based on a genetic mix of two or more different species beyond the F1 generation	Cold-tolerant tilapia in the Philippines – derived from crosses between farmed types of *Oreochromis niloticus* and *O. aureus* and *O. spilurus*
Crossbred	The F1 progeny of a cross between two primary farmed types within a species	Dongfang No. 6 kelp, a cross between a native and an introduced kelp (*Saccharina japonica*) produced in China
Polyploid	An animal or plant having more than two sets of chromosomes	Sterile triploid oysters that do not spawn and thus retain condition and market value during the breeding season
Monosex (genetic)	A single sex cohort of a given species generated through genetic manipulation of sex determination rather than direct manipulation of sex differentiation	Genetically male tilapia in *Oreochromis niloticus* produced from YY male sires, all male hybrid tilapia (*O. niloticus* female × *O. aureus* male) or all female salmonids produced from XX male sires
Transgenic	An organism in which a foreign gene (a transgene) is incorporated into its genome. The transgene is present in both somatic and germ cells, is expressed in one or more tissues, and is inherited by its offspring	Atlantic salmon (*Salmo salar*) in Canada, United States and Panama transgenic for the Chinook salmon growth hormone gene and an ocean pout promoter gene. Ornamental zebra danios (*Brachydanio rerio*) transgenic for fluorescing proteins
Gene edited	A farmed type created by the targeted insertion, deletion or replacement of DNA at a specific site in the genome that is inherited by its offspring	There are currently no gene edited farmed types being used in commercial aquaculture, although a gene edited tilapia has been developed and is under consideration for aquaculture in Argentina
	Wild relatives	
Stock (wild relative)	A group of individuals in a species occupying a well-defined spatial range independent of other stocks of the same species. Random dispersal and directed migrations due to seasonal or reproductive activity can occur. Such a group can be regarded as an entity for management or assessment purposes	Gulf of Maine stocks of Atlantic cod (*Gadus morhua*)

* From the International Treaty on Plant Genetic Resources for Food and Agriculture (FAO, 2009, **www.fao.org/3/a-i0510e.pdf**).

The *Special Session on Advancing Integrated Agriculture Aquaculture through Agroecology* was convened by FAO with support from Cirad (Centre de Coopération Internationale en Recherche Agronomique pour le Développement) and NACA (Network of Aquaculture Centres in Asia Pacific) during the joint World Aquaculture Society–European Aquaculture Society's International Conference AQUA 2018, in Montpellier, France, on 25 August 2018[1]. The objectives were to clarify how an integrated agriculture-aquaculture (IAA) system implemented within an agroecological approach could help alleviate poverty and hunger, and to identify the knowledge gaps to be filled to ensure the sustainability of IAA. Twenty five speakers presented background information and case studies in front of a full room. The following article won an audience vote for best presentation.

Ecological Approaches for Better Microbial Management in Intensive Shrimp Farming

At the FAO Global Conference on Aquaculture in Phuket, Thailand, in 2010, it was postulated that modern aquaculture requires a turning point (Sorgeloos, 2013). In other words, although the farming of aquatic plants and animals has evolved into a mature industry, too much of the technology is still based on empirical approaches; therefore, knowledge-based developments are required to make aquaculture the blue biotechnology of the future. "More microbial management for more sustainable production" and "More integrated production systems for plant and animal farming" were identified as top priorities.

Today, it is already possible to report significant progress, mainly based on novel insights regarding the role of the microbiota in aquaculture. The traditional approaches of plate count analysis and microscopy have been instrumental for increasing awareness of the huge numbers of bacteria that may interfere in aquaculture systems. Yet, these methods have been inadequate for truly understanding and showing the diversity and functionality of bacteria in aquaculture systems. This could only be achieved by application of innovative microbial research platforms, such as next generation sequencing and gnotobiotic animal models. An example of a crucial finding was that certain bacterial pathogens in aquaculture systems can regulate virulence in function of population density by means of quorum-sensing mechanisms, and as such can organize infection in fish or shrimp (Defoirdt *et al*., 2011). This immediately explained why detection of pathogens should not be used as a sole predictor of problematic animal performance, and that the overall status of the bacterial community must be considered.

The randomness in performance that is observed in aquaculture, particularly in marine fish larviculture systems, despite "full control" over the system, remains problematic. When referring to "full control", it must be admitted that this does not include microbial control. Indeed, up until now, we have operated our production systems as microbial black boxes, and we have tried to control obligate and opportunistic pathogen interference merely by repressive methods. However, based on recent microbial insights, it appears that repression is not the best approach for minimizing pathogenic disease risk (Vadstein *et al*., 2018). A targeted non-selective reduction of unwanted bacteria by disinfection to maximize biosecurity should always be followed by a selective enhancement of *wanted* microbes. By specific niche creation resulting from increased removal of nutrients and increased water retention times, K-strategic bacterial populations can be strengthened to outcompete r-strategic bacteria, the latter often being the ecology of opportunistic pathogens. The use of probiotics may be complementary to this approach, but their success can

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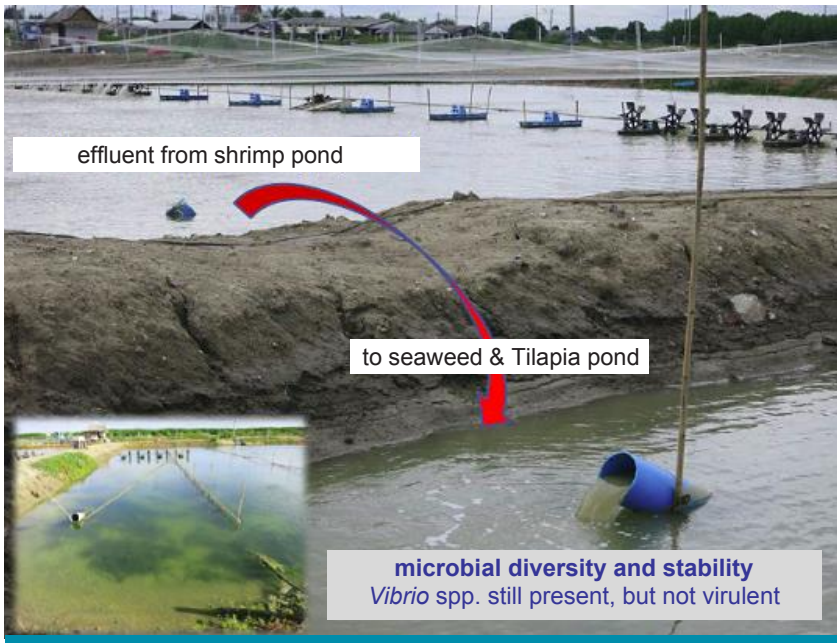
1. FAO 2019. *Report of the Special Session on Advancing Integrated Agriculture-Aquaculture through Agroecology*. Montpellier, France, 25 August 2018. FAO Fisheries and Aquaculture Report No. 1286. Rome. (also available at: **www.fao.org/3/ca7209en/CA7209EN.pdf**).

substantially be increased when applied in system settings that support their ecology. The result is a substantially lower disease risk as compared to one derived from a repression approach alone.

Our belief in this approach is strengthened by the empirical observations of improved performance made in biofilter-containing recirculation systems for hatchery and nursery production of marine fish and shrimp, as well as in the new concepts of intensive shrimp farming, such as zero water exchange ponds with shrimp toilets for increased waste removal and connected with extractive ponds stocked with tilapia or Caulerpa seaweed in recirculation models. In such systems, there seems to be an intrinsic microbial selection mechanism that counteracts the (development and) dominance of opportunistic pathogens such as *Vibrio* spp., and hence lowers the risk of opportunistic – and unpredictable – pathogen interference by maintaining their densities below the critical quorum-sensing density.



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Zero water exchange system for intensive shrimp farming in Thailand

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Treatment ponds in zero water exchange system for intensive shrimp farming in Thailand: sedimentation pond (shrimp toilet), brackishwater 'red' Tilapia and *Caulerpa* seaweed

Through more collaborative research regarding the microbiome and its functionality in the variety of aquaculture systems mentioned above, empirical observations can form the foundation of science-driven and more knowledge-based aquaculture. The use of novel upcoming methods, such as flow cytometry coupled to cell sorting and next generation sequencing, will surely amplify the current level of understanding substantially, and as such contribute to more predictable aquaculture performance.

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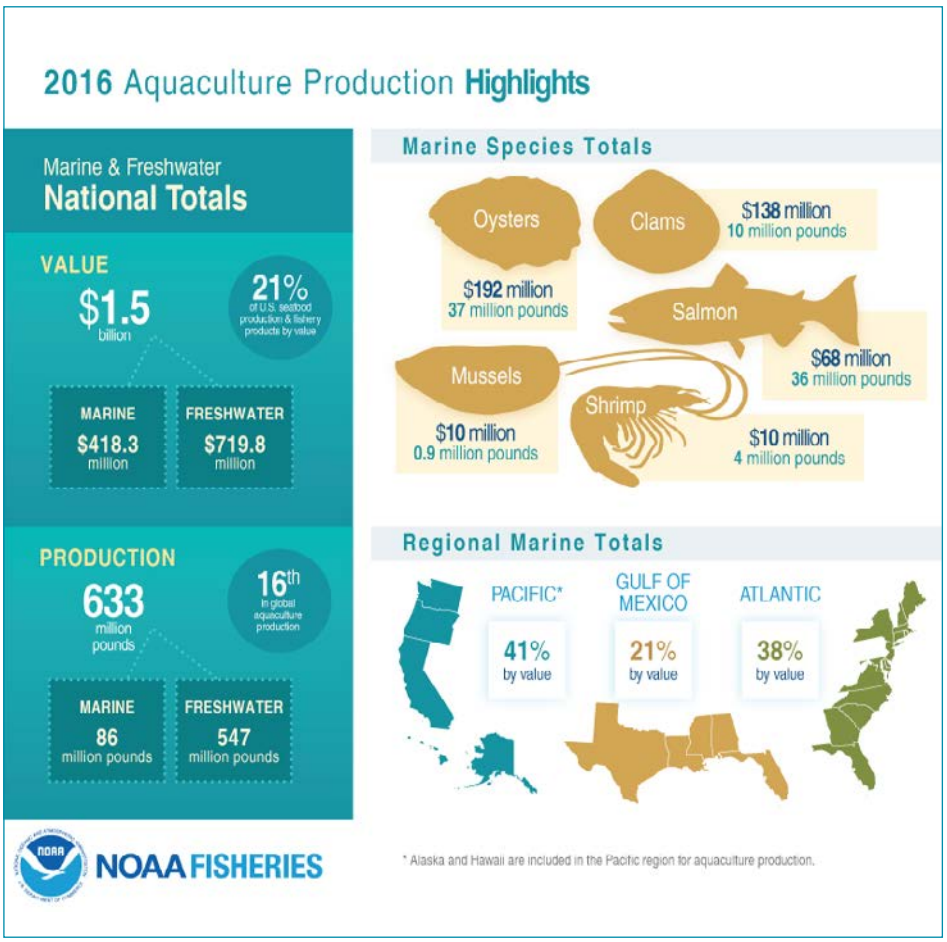
Aquaculture in the United States of America

Seafood is the anchor of cultural identity and economic strength along the coast of the United States of America. Seafood remains a foundation of many coastal communities despite changing oceans and the limited availability of wild seafood to harvest, in part because of the growth of marine aquaculture. As United States capture fisheries approach full sustainable harvest, many people are now looking to increase marine aquaculture driven by interest in bolstering local economies and creating jobs for coastal residents.



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Current marine aquaculture production in the United States is almost exclusively in nearshore coastal waters, within three nautical miles of shore. These areas require some federal authorizations, but are managed primarily by individual states, and thus rules vary from state to state. For example, while there are states in which the production of finfish in pens is not permitted, other states are proactively working to find appropriate space in their waters for finfish farms, shellfish and seaweed, hoping to enable industry growth.

In 2016, seafood production had a value of USD 6.9 billion in the United States, with marine and freshwater aquaculture production contributing USD 1.5 billion, equal to about 21 percent of the combined total of commercial wild catch and aquaculture.

In addition to the economic strength of coastal communities, another driver for the interest in developing a larger marine aquaculture industry in the United States is the simple need for more seafood. The seafood production of the United States, both wild harvested and farmed, is not enough to meet the country's seafood demands. The United States is the largest global importer of seafood and has the world's largest seafood supply deficit at over USD 16 billion (SOFIA, 2018). In addition to this national-level deficit, there is a global seafood supply gap forecasted; the United States could play a role in filling the gap.

Marine aquaculture has received significant attention in recent

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years. The United States has one of the world's largest exclusive economic zones, which translates to significant opportunity to increase marine aquaculture production. The United States has the technical expertise, seafood infrastructure (ports, processing, transport) and space to be a leader in aquaculture production technologies, sustainable practices and overall volume of seafood produced.

The United States Government has spent the last decade working with states, industry, universities, fishing associations, environmental groups and others to facilitate aquaculture production in coastal nearshore waters and to prepare a regulatory framework for aquaculture in federal offshore waters along with the siting and science required to manage an expanding industry in a way that sustains healthy oceans. Despite these efforts, growth has been slow, energizing a renewed focus over recent years to understand what has been hindering faster development.

A few main impediments to the growth of sustainable marine aquaculture in the United States are regulatory uncertainty, lack of an efficient and predictable permitting process, social acceptance of aquaculture ventures in marine waters, including user conflicts for space, and a gap in underpinning research, appropriately scaled for successful development of the industry. To begin resolving these issues, work is being done across the federal government.

The United States Department of Commerce, which is home to the National Oceanic and Atmospheric Administration (NOAA) and its National Marine Fisheries Service, has made aquaculture a Departmental priority. In the 2018–2022 Strategic Plan for the Department, "Increase [Marine] Aquaculture Production" is identified as a strategic objective, with two strategies nested therein: (i) provide a one-stop shop for federal approval of marine aquaculture permits; and (ii) support research to advance marine aquaculture. The National Marine Fisheries Service is actively working on these strategies with partner agencies to achieve the Departmental objective by 2022.

In addition to this high-level focus on marine aquaculture within the Executive Branch of the United States Government, there has been increased attention from the United States legislature. In 2018, legislation intended to resolve issues related to regulatory uncertainty and support research was introduced. Both the Senate and the House of Representatives introduced the Advancing the Quality and Understanding of American Aquaculture Act (or the AQUAA Act) but it did not pass before the end of the Congressional session, resulting in its expiration. Attention to marine aquaculture in the legislature has, however, continued in the current Congress. Recently, there was a Senate hearing titled "Feeding America: Making Sustainable Offshore Aquaculture a Reality," and introduction of legislation.

Although marine aquaculture specifically has benefited from a significant increase in visibility within the United States Government, the highest-level work in the Executive Branch is across both the marine and freshwater sectors, through the efforts of the Subcommittee on Aquaculture (SCA) under the National Science and Technology Council. The SCA, which is co-chaired by the White House Council on Environmental Quality, NOAA and the United States Department of Agriculture, is an interagency body created to coordinate research and management of aquaculture activities across all federal government agencies.

The SCA has two main work products under development that are expected to help spur industry development and investment. The first is a National Strategic Plan for Federal Aquaculture Research 2020–2024. This document will set a national vision for coordinated federal aquaculture research in the NOAA as well as individual goals to attain over the four-year period. The second major work product of the SCA is a Work Plan for a Federal Aquaculture Regulatory Task Force. The draft Work Plan outline, released in October 2019, highlights three goals: (i) improve the efficiency and predictability of [marine] aquaculture permitting in state and federal waters; (ii) implement a national approach to aquatic animal health management of aquaculture; and (iii) refine and disseminate tools for aquaculture regulatory management.

The intensifying energy and ongoing motivated work towards developing a strong aquaculture industry makes this an exciting time for the development of seafood production in the United States. Should the efforts of industry, academia, environmental organizations and the government working together prove fruitful, the seafood landscape in the United States will be very different ten years from today, with significantly higher production from domestic aquaculture.

Aquaculture Feed Ingredients

In recent decades, the consumption of healthy food has resulted in an increase of global demand for aquatic food, which enabled a rapidly growing aquaculture sector in several countries and regions. However, one of the limiting factors to the expansion of aquaculture is the high cost and the limited availability of some aquafeed ingredients, specifically fishmeal and fish oil. This is especially important because these ingredients are considered vital to aquaculture production due to their excellent nutritional value, including their good profile of essential amino acids, high digestibility and composition of essential fatty acids. Although they are extremely valuable ingredients for the animal diet, these raw materials are mainly sourced from wild fisheries, which are subject to seasonal fluctuations, sometimes with negative environmental impact. Thus, research initiatives aimed towards alternative aquafeed ingredients to meet the nutritional requirements of aquatic animals, at a lower cost and with less environment damage and greater sustainability, are fundamental to achieving the continuing growth and development of sustainable aquaculture systems.

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Small scale feed mill in Bangladesh producing extruded feed for *Pangasius* catfish

Currently, several new initiatives have come up regarding the incorporation of alternative aquafeed ingredients. Feeding trials using fish pellets made with plant-based ingredients, including soya bean protein, canola meal and camelina meal, are being conducted to guide aquafeed producers in the selection of feed containing agricultural products. The challenge of alternative feed ingredients is to reduce or replace fishmeal and fish oil while maintaining nutritional requirements, improving feed conversion and lowering costs. Ingredients derived from plant protein provide encouraging results in aquafeed despite their restrictions, such as imbalanced amino acid profiles or antinutrient factors. Other promising results have shown that up to 50 percent plant protein replacing fishmeal did not cause any adverse effects on feed intake or growth in rainbow trout and red hybrid tilapia. Similar tests have also shown that fish oil can be replaced by plant-like organisms, as some genera of marine microalgae such as *Nannochloropsis* and *Schizochytrium* are oleaginous and can produce large quantities of omega-3 fatty acids. In addition to alternative ingredients derived from plants, use of low-cost animal protein sources have recently been tested and grown – a promising and sustainable alternative to fishmeal is the use

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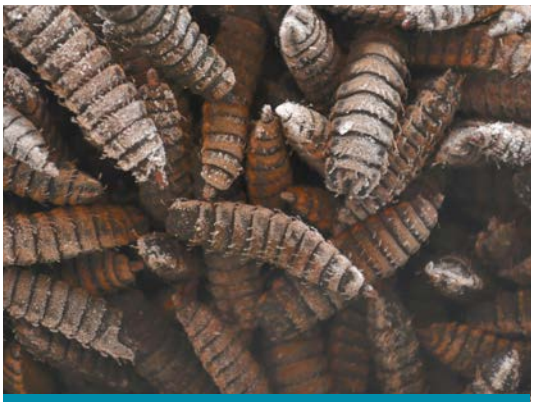
of insect meal. Insects not only have high protein content, but also a small ecological impact. Studies have shown that the use of insect meal from the black soldier fly seems to be promising, and fish fed with insect meal were the most valued products by consumers regarding environmental impact compared to current fish feeding systems. Other alternative ingredients are the protein hydrolysates from by-products of the food industry. Residues of fish filleting, such as skin, muscle, viscera and the by-product of poultry as offal, are commonly used to produce protein hydrolysates. These hydrolysates have bioactive compounds, essential nutrients and are potential sources of the antioxidant peptide; these hydrolysates have shown promising results.

Several alternative ingredients have strong potential for use in aquafeeds. However, within use for commercial formulas and species, there is still much work to be done. Furthermore, when evaluating ingredients, the use of indicators as to economic, environmental and social sustainability could prove to be useful towards building a broader sustainability assessment for the aquaculture industry. Additionally, surveys of consumer opinion and public outreach highlighting the sustainability of these ingredients are important in order to publicize the positive impacts of aquaculture. Therefore, it is necessary that producers, industry and academia join forces in order to bring all key players to the aquaculture sector, aided by financial investments from private and public sectors.



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Larvae of the Black Soldier Fly (*Hermetia illucens*)

Aquaculture Governance in Africa: Towards Food Security and Poverty Alleviation

©FAO/A. MENEZES

Blue Economy Conference, Kenya

Often we speak about aquaculture sustainability referring to: economic viability, environmental integrity and technical feasibility. Aquaculture enterprise, be it at small, medium or large scale also implies good governance. As with any enterprise, aquaculture should not only be technical and environmentally sustainable but also profitable and socially acceptable. It is necessary for farmers to understand and utilize appropriate technologies (imported or locally produced) and to use them properly in the production system (technical sustainability). To be economically viable (economic sustainability), aquaculture has to generate

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good and competitive profits. Otherwise, farmers will shift their efforts towards better opportunities, which is often the cause for the abandonment of aquaculture ventures. Social soundness means that aquaculture should be socially acceptable (social sustainability and social equity).

Good governance implies that policies, laws and institutions should provide a predicable business environment; without the rule of law, there will be little predictability and security to reassure investors (Governance sustainability). While participatory governance has become the fore model in many countries, it is still invisible in the existing policies documents and decision-making processes. For instance, in Sub Saharan Africa, fisheries and aquaculture sectors are not adequately embedded in policy documents dealing with poverty alleviation, foreign currency generation, food security, ecosystem approach to fisheries and to aquaculture, and gender mainstreaming at both country and regional level.

In Africa, fisheries and aquaculture play an important role in food security for consumers, direct producers, value chain actors and the wider community. Directly, fisheries and aquaculture complement the diet of millions households, as fish is the main source of animal protein in certain communities. They also contribute indirectly to food security by generating sales revenues and employment income with which other food items are purchased. Wealth generation is expanded along the value chain, domestic and regional markets, reaching other stakeholders and populations. Unfortunately, the exact contribution of the fisheries and aquaculture sector to food security and nutrition in many African countries is unknown and may have been underestimated.

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Tilapia hatchery ponds on the shores of Lake Muhazi, Rwanda

Walking the talk

With the goal of raising awareness among decision-makers about the contribution of aquaculture to food security, nutrition and poverty eradication in African countries, FAO is preparing a publication that presents one broader "*Assessment of the Integration of Fisheries and Aquaculture into Policies for Food Security and Poverty Alleviation: Framework and Application in African Countries*". This assessment was prepared by the Aquaculture Branch of FAO Fisheries and Aquaculture Department (FIAA) with inputs from the FAO Regional Office for Africa (RAF) and presented in different stakeholder meetings[1]. It aims at assisting African countries and regional bodies to conduct an inward evaluation of actions taken by them to improve the integration of the fisheries and aquaculture sector into policy documents for achieving food security and nutrition, poverty eradication and gender mainstreaming. The assessment proposed a research methodology to assess the current extent of integration of the sector into policy documents, at both country and regional level in Africa.

In addition, it is expected that the results of this assessment will guide the mainstreaming of sustainable aquaculture development within wider policy frameworks, reveal the contribution of fisheries and aquaculture to national development goals, and incidentally result in the allocation of funding for the promotion of the sectors at national and regional level.

1. (a) Consultative and validation meetings on "improving policy development in aquaculture in support of food security, nutrition and poverty eradication" took place in Addis, Ethiopia (3 to 4 December 2018), Windhoek, Namibia (37th meeting of the Technical Committee on Fisheries, 18-20 March 2019), and Kigali, Rwanda from 10 to 14 June, 2019.

Remembering our Colleague, Michel M. J. Vincke 1931–2019

Michel M. J. Vincke was born in Oudenburg, a small community east of Oostende in the Flemish-speaking part of Belgium, where his family ran a well-known horticulture business. As a young boy, Michel experienced war-time Belgium and the trauma of losing both of his parents.

In 1952, after graduating as an "Ingénieur Technicien", Michel left for the Democratic Republic of the Congo (then known as the Belgian Congo) where he met Jeanine Vivier, a physiotherapist, who soon became his wife. From then on, throughout more than 60 years together, Jeanine provided Michel with a solid and unwavering support. Upon his arrival, Michel became responsible for fish farming and lake management in the Province of Katanga, which included administering fisheries in the eastern part of Lake Tanganyika. It was also during this time that Michel started his career in tropical freshwater fish culture. Michel was to remain in Africa, with only brief interruptions, for the next 24 years. He dedicated himself to improving and spreading fish culture in the Democratic Republic of the Congo, Madagascar and the Central African Republic. Many of those who knew him at that time were struck by Michel´s dedication and skill in adapting new technologies to local conditions. He loved this work and it was the happiest period in his life.

In 1977, Dr R. Pillay, in charge of the global "Aquaculture Development and Coordination Programme" based at FAO headquarters in Rome, came to know Michel. Dr Pillay was convinced that his knowledge, experience and dedication were essential, not only for Africa, but also globally.

At FAO headquarters, Michel soon became a well-known staff member in the F building, where others – often the younger staff members, eager to learn or laugh – would visit him in his office or find a chair at his table in the coffee bar. Michel became a discreet, trusted and valued adviser to

Dr Pillay. He reviewed and proposed policies for aquaculture in a number of countries, chiefly in Africa, but also elsewhere, such as Argentina, Haiti, Jamaica and the Dominican Republic. While in the field, Michel would always seek out opportunities to provide practical advice to those involved in fish culture.

Michel was an astute observer of human beings and their surroundings. Those who had the pleasure of travelling with him soon learned how many trees or flowers along the road they had missed, or how only partially they had understood the chemistry with the individuals they had encountered.

Michel also had a clear philosophy of life. From an early age he had learned that purposeful activity should be pursued and waste avoided. This daily approach was strengthened when Michel experienced life in the African bush. Later in life, Michel would find it hard to have professional discussions with those who opined on subjects on which they had only rudimentary knowledge and little experience.

In May 2019, Michel died peacefully of multiple causes in Veurne, a few kilometres from Oudenburg, surrounded by Jeanine and their three sons with their families.

COLLEAGUES IN MOTION

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Nathanael Hishamunda

Senior Officer, Fisheries and Aquaculture Department

Dr Nathanael Hishamunda holds a BSc in Agronomy and an Engineering degree in Agriculture from the National University of Rwanda, a MSc in Aquaculture Economics and a PhD in Agricultural Economics with specialization in agricultural policy and international trade and development from Auburn University, Alabama, USA. He has over 33 years of professional experience in aquaculture economics and management and international development, especially in developing countries, having served as Head of the Rwanda Aquaculture Extension Service, Director of the Rwanda National Aquaculture Service, Senior Fishery Planning Officer, and Senior Aquaculture Economics, Policy and Planning Officer at FAO, where he coordinated a team of economists dealing with complex economic, social, policy, governance and institutional issues of national, regional and global importance to ensure sustainable aquaculture development; most recently, he was FAO Representative in Haiti, from September 2016 to October 2019. The Aquaculture Branch welcomes him back as Senior Fishery (Aquaculture) Officer.

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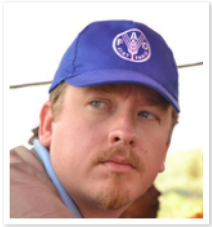

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Austin Stankus

Aquaculture Officer, Aquaculture Branch

Austin Stankus, an American national, joined the Aquaculture Branch in October 2019 as an Aquaculture Officer. First starting with FAO in 2013, his work has focused primarily on cross-sectoral approaches to integrated agriculture-aquaculture systems. Austin has returned to headquarters from the FAO Subregional Office in Barbados, where he supported the establishment of aquaponic and seamoss demonstration systems to increase resilience of aquaculturists to the impacts of climate change. One of the key responsibilities at FAO will be supporting the Branch through coordination of the development and maintenance of aquaculture information products and publications, including the *FAO Aquaculture Newsletter*. Austin holds a MSc in Zoology from the University of Hawai'i where his studies and work centred on aquaponics and insect-based composting of food waste as an alternative fish feed. He also supported community-based urban forestry mapping and spatial planning of the campus landscape. He holds a BSc in marine biology, with work focused on apex marine predators, including sharks, rays and pelagics.

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Zixin Wei

Volunteer, Aquaculture Branch

Zixin Wei, a Chinese national, joined the FAO Aquaculture Branch in August 2019 as a volunteer for one month. She is a third-year student at Shanghai Ocean University majoring in Marine Technology. Her college research involves an innovative project titled "Beach Mapping with Unmanned Vehicles", which has enhanced her research ability and problem-solving ability. At FAO, she worked with a team of interns – Liu Yuxing and Jian Dong – in support of a research programme called "Relationship Between Mangrove Loss and Aquaculture Expansion in Viet Nam", which investigated the factors associated with deforestation and the environmental impact of aquaculture.

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Omar Elhassan

Consultant, Aquaculture Branch

Omar Elhassan, an American-Sudanese national, joined the FAO Aquaculture Branch as an aquaculture biosecurity consultant. He previously conducted various research projects on environmental antimicrobial resistance (AMR) mechanisms, pathways and persistence in urbanizing and rural watersheds as well as environmental remediation of polluted lakes in Texas, United States. Through his studies, research and work experience, Omar has become specialized in soil health and management, sustainable agriculture, environmental toxicology, international development and cooperation, and management of non-profit organizations. Omar has experience working with small non-profits in forging and maintaining partnerships and ensuring project sustainability, specifically to provide access to clean water to underrepresented communities in Central America through the dissemination of knowledge, skills and tools necessary for self-sufficiency. Omar is working under the guidance of Melba Reantaso, assisting in a number of aquatic animal health projects providing support for the Aquaculture Biosecurity Component of FAO's Global Aquaculture Sustainability Programme.

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Dong Jian

Intern, Aquaculture Branch

Dong Jian, a Chinese national, joined FAO in July 2019 for a three-month internship in the Aquaculture Branch. An undergraduate majoring in Physical Oceanography at Shanghai Ocean University, Jian will pursue further education in marine affairs. Before joining FAO, he participated in the Comprehensive Survey Group of Marine Science organized by the Chinese Government. At FAO, he worked with a team of interns – Zixin Wei and Jian Dong – in support of a research programme called "Relationship Between Mangrove Loss and Aquaculture Expansion in Viet Nam", which investigated the factors associated with deforestation and the environmental impact of aquaculture.

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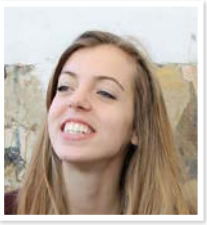

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Giulia Galli

Intern, Aquaculture Branch

Giulia Galli, a German-Italian national, joined the Aquaculture Branch for a six-month internship, starting in October 2019. She studied at University College London, United Kingdom, where she recently graduated with a first-class Bachelor of Science degree in History and Philosophy of Science.

During her internship at FAO, Giulia will contribute to the development of World Aquaculture Performance Indicator (WAPI) factsheets and policy briefs, and will also support the development of the website of the 2020 Global Conference on Aquaculture. She is passionate about cultures, interested in climate change and the changing relationship of human culture and the natural environment, and strives to understand how science and technology may be implemented to improve future livelihoods.

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Liu Yuxing

Volunteer, Aquaculture Branch

Liu Yuxing, a Chinese national, joined the FAO Aquaculture Branch in August 2019 for a one-month volunteer programme. As an undergraduate at Shanghai Ocean University, Liu is studying Marine Technology with a second major in Computer Science. She was once a member of the "China 100 Youth Excellent Training Program", a public welfare project aiming at cultivating young social talent with a sense of social responsibility, social progress, leadership and international vision. At FAO, she worked with a team of interns – Zixin Wei and Jian Dong – in support of a research programme called "Relationship Between Mangrove Loss and Aquaculture Expansion in Viet Nam", which investigated the factors associated with deforestation and the environmental impact of aquaculture.

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Lei Gao

Intern, Aquaculture Branch

Lei Gao, a Chinese national, joined FAO in July 2019 for a nine-month internship. He is a doctoral candidate at Shanghai Ocean University, focusing on molecular genetics and molecular development related studies to research fish disease resistance through gene editing technology and the metamorphosis development of flatfish. Lei is providing support to ongoing activities surrounding the Global Plan of Action for Conservation, Sustainable Use and Development of Aquatic Genetic Resources, and the development of a global information system for farmed types. He is also summarizing the conservation status of global aquaculture species and will provide support on the media aspects of Aquatic Genetic Resources for Food and Agriculture.

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Danielle Blacklock

Visiting Expert, Aquaculture Branch

Danielle Blacklock, an American national, joined the Aquaculture Branch from the United States Government agency, the National Oceanic and Atmospheric Administration (NOAA), for a six-month rotation as part of a leadership development programme. At NOAA, Danielle is the senior policy adviser for aquaculture in the National Marine Fisheries Service, where she serves as a member of the leadership team for strategic planning, governance and policy of marine aquaculture in the United States. Danielle holds a Bachelor of Science degree in Marine Science from the University of Maine and a Master of Science degree in Marine Affairs from the University of Washington. Danielle has over 15 years of experience in marine resource management, including ten years at NOAA, working in a number of different positions throughout the agency. Before her time at NOAA, she taught at the Sea Education Association's Sea Semester programme for five years, sailing the high seas with undergraduate students.

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FAO Fisheries and Aquaculture Technical Papers (FATP)

FAO 2020

Strengthening, empowering and sustaining small-scale aquaculture farmers' associations

Hasan, M.R., Bueno, P.B. and Corner, R.A. eds. 2020.
FAO Fisheries and Aquaculture Technical Paper No. 655. Rome, FAO.

This technical paper presents three major sets of information resource: (i) five case studies from five Asian countries, (ii) the synthesis of the case studies and (iii) the report of the regional workshop that reviewed the case studies and the draft synthesis of the case study reports, provided additional science-based, professional, and experiential information, and developed recommendations to strengthen, empower and sustain organizations of small-scale fish farmers and related aquaculture-based enterprises..

The PDF can be accessed directly at: **www.fao.org/3/ca7741en/CA7741EN.pdf**
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Workshop Proceedings and Reports

FAO 2019

Report of the Third Session of the COFI Advisory Working Group on Aquatic Genetic Resources and Technologies

Rome, 20–21 August 2019.
FAO Fisheries and Aquaculture Report No. 1297. Rome.

This report contains the main discussion points and general conclusions and recommendations from the third session of the Working Group convened from 20-21 August 2019 in FAO headquarters, Rome, Italy. The working group considered a range of issues including: a brief review of the process of preparation of the first report on The State of the World's Aquatic Genetic Resources for Food and Agriculture; (SoWAqGR); the preparation of a GPA on AqGR (GPA); the development of a global information system on aquatic genetic resources including a registry of farmed types; the development of a strategic approach to work on AqGR at FAO; and reviewed its terms of reference (ToR) and update its workplan. A series of recommendations were made to FAO and to the Committee on Fisheries' sub-committee on aquaculture.

The PDF can be accessed directly at: **www.fao.org/3/ca7245en/CA7245EN.pdf**
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FAO Committee on Fisheries 2019

Report of the Tenth Session of the Sub-Committee on Aquaculture

Trondheim, Norway, 23–27 August 2019.
No. 1287. Rome, Italy.

This document presents the adopted report of the tenth session of the Sub-Committee on Aquaculture of the FAO Committee on Fisheries (COFI), held in Trondheim, Norway from 23 to 27 August 2019. The Sub-Committee provides a forum for consultation and discussion on aquaculture-relevant topics, advises COFI on related technical and policy matters, and provides guidance for the future work.

The PDF can be accessed directly at: **www.fao.org/3/ca7417t/CA7417T.pdf**

FAO 2019

Report of the FAO Regional Training Workshop on Innovative Integrated Agro-Aquaculture for Blue Growth in Asia-Pacific

Kunming, China, 12–17 June 2017.
FAO Fisheries and Aquaculture Report. No. 1292. Rome.

The FAO Fisheries and Aquaculture Department and FAO's Regional Office for Asia and the Pacific jointly sponsored and implemented a regional training workshop to support scaling up of innovative integrated agro-aquaculture (IAA) for Blue Growth in selected countries in the Asia-Pacific region at Fubao Culture Town & Spa Hotel in Kunming, Yunnan province, China, from 12 to 17 June 2017. As an FAO Reference Centre for Aquaculture and Inland Fisheries Research and Training, and as the technical backstopping agency for the successful introduction of integrated rice-fish culture practices in Hani terraced rice fields, the Freshwater Fisheries Research Centre (FFRC) of the Chinese Academy of Fishery Sciences (CAFS) partnered with FAO in the organization of the training workshop.

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FAO 2019

Report of the Special Session on Advancing Integrated Agriculture-Aquaculture through Agroecology

Montpellier, France, 25 August 2018.
FAO Fisheries and Aquaculture Report No. 1286. Rome.

A workshop, aimed at collecting and documenting the diversity of integrated agriculture aquaculture practices (IAA), was organized on 25 August 2018 in Montpellier during the International conference AQUA 2018 of the World and European Aquaculture Societies. The objectives were to clarify how an IAA implemented within an agroecological approach could help alleviating poverty and hunger, and to identify the knowledge gaps to be filled to ensure the sustainability of IAA. Twenty-five speakers presented background information and case studies.

The PDF can be accessed directly at: **www.fao.org/3/ca7209en/CA7209EN.pdf**
The document card can be found here: **www.fao.org/documents/card/en/c/ca7209en**

FAO 2020

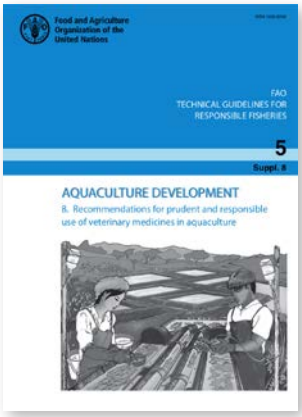
Report of the FAO Expert Working Group Meeting "Scoping Exercise to Increase the Understanding of Risks of Antimicrobial Resistance (AMR) in Aquaculture

Palermo, Italy, 26–29 November 2018.
FAO Fisheries and Aquaculture Report No. 1268. Rome.

increase the understanding of risks of antimicrobial resistance (AMR) in aquaculture". The meeting was attended by 14 experts from nine countries, representing intergovernmental organizations, academia, research institutions and the private sector. A risk profiling exercise was conducted on two bacterial pathogen groups (*Streptococcus* spp. and *Vibrio parahaemolyticus*) selected based on their importance to fish health and public health. Both bacterial agents affect tilapia, the second largest species group produced in aquaculture globally, which contributes significantly to global food and nutrition security. The risk profiling exercise for the two bacterial pathogens revealed that in both cases, the AMR risks posed by these pathogens were likely to be low and thus conducting a full risk assessment was not recommended. The risk profiling outlined in Codex Alimentarius was used as guidance, but it was recommended to review and adapt it as appropriate for aquatic AMR risk assessment. The Expert Group agreed to develop a project proposal to contribute to a multisectoral project "Towards reducing aquaculture-based AMR through a cross-sectoral approach". The project concept note will include investigation on two bacterial agents important to both animal and human health, namely: Streptococcus spp. and mesophilic aeromonads.

The PDF can be accessed directly at: **www.fao.org/3/ca7442en/CA7442EN.pdf**
The document card can be found here: **www.fao.org/documents/card/en/c/ca7442en**

FAO Technical Guidelines for Responsible Fisheries



FAO 2019

Aquaculture development. 8. Recommendations for prudent and responsible use of veterinary medicines in aquaculture

FAO Technical Guidelines for Responsible Fisheries. No. 5. Suppl. 8. Rome.

These Technical Guidelines on the Prudent and Responsible Use of Veterinary Medicines in Aquaculture (No. 5 Suppl. 8) are developed to support Section 9 – Aquaculture Development of FAO's Code of Conduct for Responsible Fisheries (CCRF) and The FAO Action Plan on Antimicrobial Resistance 2016–2020. They also support the international aquatic animal health standards of the World Organisation for Animal Health (OIE), the food safety standards of the FAO/WHO Codex Alimentarius and the One Health platform under the FAO/OIE/WHO Tripartite Collaboration on antimicrobial resistance (AMR). Their objective is to assist countries in encouraging the prudent and responsible use of veterinary medicines (antimicrobials and other chemotherapeutants) in aquaculture production through appropriate government regulation and the promotion and encouragement of awareness and responsible use by the private sector. They emphasize, among the guiding principles, that responsible use of veterinary medicines in aquaculture requires collaboration among all stakeholders and a strong commitment to governance, awareness, best practices, surveillance and research, including monitoring of AMR, tracking of antimicrobial usage (AMU), assessing risk in different settings and evaluating strategies to reduce AMR and maintain efficacy of antimicrobials. They provide general guidance on the use of veterinary medicines in aquaculture to responsible government agencies, private-sector aquaculture producers and aquatic animal health professionals..

The PDF can be accessed directly at: **www.fao.org/3/ca7029en/CA7029EN.pdf**
The document card can be found here: **www.fao.org/documents/card/en/c/ca7029en**

FAO Circulars

FAO 2019

Welfare of fishes in aquaculture

Segner. H., Reiser, S., Ruane, N., Rösch, R., Steinhagen, D. and Vehanen, T. 2019.
FAO Fisheries and Aquaculture Circular No. REU/C1189. Budapest, FAO.

The welfare of fish in aquaculture is of increasing public concern in Europe and thus of growing importance for fish farmers. There is an urgent need for fish farmers, authorities and scientists to develop criteria, approaches and practices to monitor and safeguard the welfare of culture fish. This report focuses primarily on the culture conditions for farming of freshwater finfish, but marine species are included where appropriate. It gives little attention to welfare aspects related to transport and slaughter and does not address capture fisheries, neither commercial nor recreational. These findings are the result of a project administered under the European Regional Fisheries and Aquaculture Advisory Commission (EIFAAC).

The PDF can be accessed directly at: **www.fao.org/3/ca5621en/CA5621EN.pdf**
The document card can be found here: **www.fao.org/publications/card/en/c/CA5621EN/**

FAO 2019

Risk management practices of small intensive shrimp farmers in the Mekong Delta of Viet Nam

Pongthanapanich, T., Thi Nguyen, K. and Jolly, C.M. 2019.
FAO Fisheries and Aquaculture Circular No. 1194. Rome, FAO.

This study examines the characteristics of small intensive shrimp farms and socio-economic status of the farm households, and farming practices and performance that are associated with the strategies and preferences for managing production risks. The analysis was based on primary data from a survey of farms raising the whiteleg shrimp (Penaeus vannamei) conducted in Bac Lieu, Ben Tre and Ca Mau provinces from September 2017 to February 2018.

The PDF can be accessed directly at: **www.fao.org/3/ca6702en/CA6702EN.pdf**
The document card can be found here: **www.fao.org/documents/card/en/c/ca6702en/**

FAO 2019

The performance of antimicrobial susceptibility testing programmes relevant to aquaculture and aquaculture products

Smith, P. 2019.
FAO Fisheries and Aquaculture Circular No. 1191. Rome, FAO.

This Circular addresses best practice guidelines for the performance of these susceptibility tests. Section 1 discusses the relevance of this document to The FAO Action Plan on Antimicrobial Resistance 2016-2020. Section 2 provides a general background to the principles of antimicrobial susceptibility testing. Section 3 discusses the current status of the standard protocols that can be recommended for use in antimicrobial susceptibility testing of bacteria isolated from aquatic animals. Following a consideration of 44 species of bacteria that represent those most frequently isolated from aquatic animals, it demonstrates that the currently available standardized protocols are adequate for the determination of the antimicrobial susceptibility of 37 of them (84 percent). Section 4 discusses the importance of the design of programmes aimed at monitoring or surveillance of antimicrobial resistance associated with the use of antimicrobial agents in the rearing of aquatic animals. In this paper four designs are outlined, each of which will provide data for programmes aimed at answering different questions. Section 5 provides some conclusions, while Section 6 gives a list of references. The Circular is supported by four annexes that provide: (i) a listing of Clinical and Laboratory Standards Institute (CLSI) documents cited in the paper; (ii) a list of the antimicrobial agents most commonly used in aquaculture; (iii) notes on the selection of test protocols for selected Gram-positive cocci; and (iv) guidance on the possible use of epidemiological cut-off values in a clinical context.

The PDF can be accessed directly at: **www.fao.org/3/ca6028en/CA6028EN.pdf**
The document card can be found here: **www.fao.org/documents/card/en/c/ca6028en**

FAO 2019

Shrimp infectious myonecrosis strategy manual

Tang, K.F.J., Bondad-Reantaso, M.G. & Arthur, J.R. 2019.
FAO Fisheries and Aquaculture Circular No. 1187. Rome, FAO.

This Shrimp infectious myonecrosis strategy manual provides key information for national policy-makers relevant to the development of contingency plans for countries, producers and other stakeholders with regard to outbreaks of infectious myonecrosis (IMN), a viral disease of farmed marine penaeid shrimp that is listed by the World Organisation for Animal Health (OIE). IMN is a viral disease, discovered in 2002, that has caused substantial mortalities in populations of cultured Pacific whiteleg shrimp (*Penaeus vannamei*) initially reported in Brazil (2002) and Indonesia (2006) and recently in India (2016) and Malaysia (2018). The purpose of this manual is to provide support for the various components of a national contingency plan. The information provided includes: (1) the nature of IMN: providing a brief review of disease etiology, susceptible species and global distribution; (2) diagnosis of infection: describing the gross clinical signs of disease, field diagnostic methods, differential and laboratory methods for diagnosis; (3) prevention and treatment: providing information on vaccination, and resistance and immunity of the hosts; (4) epidemiology: providing information on IMNV's geographic distribution, persistence in the environment, modes of transmission, vectors and reservoir hosts, factors influencing disease transmission and expression, and impact of the disease; (5) principles of control and eradication: describing the methods and (6) policy development and implementation: summarizing the overall policy, IMN-specific objectives, problems, overview of response options, strategies for eradication and control, capacity building and funding and compensation.

The PDF can be accessed directly at: **www.fao.org/3/ca6052en/CA6052EN.pdf**
The document card can be found here: **www.fao.org/documents/card/en/c/ca6052en**

FAO 2019

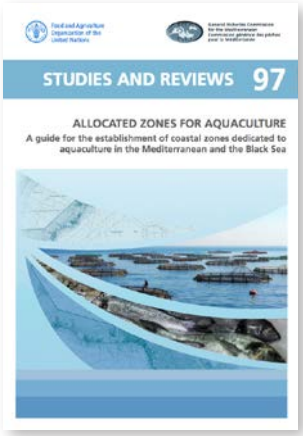
Social and economic performance of tilapia farming in Brazil

Barroso, R.M., Muñoz, A.E.P. and Cai, J. 2019.
FAO Fisheries and Aquaculture Circular No. 1181. Rome, FAO.

Tilapia is the most popular aquaculture species item farmed in over 120 countries or territories worldwide. Global tilapia aquaculture production grew 11 percent annually (or 13 percent in terms of farmgate value) over the past three decades, from 0.3 million tonnes (USD 304 million) in 1987 to 5.9 million tonnes (USD 11 billion) in 2017. Aquaculture production in Brazil increased 14 percent annually (or 12 percent in terms of farmgate value), from 13 000 tonnes (USD 56 million) in 1987 to 595 000 tonnes (USD 1.5 billion) in 2017, making it a regional aquaculture powerhouse contributing to 20 percent of Latin America and the Caribbean's aquaculture production in 2017. In Brazil, tilapia has been the largest aquaculture item, contributing to nearly half of the country's aquaculture production tonnage in 2017. This document assesses tilapia farming and the value chain in Brazil by examining tilapia farming technology and practices, dissecting the tilapia value chain, evaluating the sector's social and economic performance, discussing the importance of proper governance to the sector development, and highlighting potentials, issues, constraints and challenges in the development of tilapia farming or aquaculture in general in Brazil.

The PDF can be accessed directly at: **www.fao.org/3/ca5304en/CA5304EN.pdf**
The document card can be found here: **www.fao.org/documents/card/en/c/CA5304EN/**

FAO Non-serial Publications



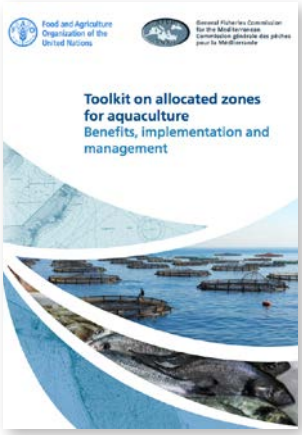
FAO/GFCM 2019

Allocated zones for aquaculture: a guide for the establishment of coastal zones dedicated to aquaculture in the Mediterranean and the Black Sea

Macias, J.C., Avila Zaragozá, P., Karakassis, I., Sanchez-Jerez, P., Massa, F., Fezzardi, D., Yücel Gier, G., Franičević, V., Borg, J.A., Chapela Pérez, R.M., Tomassetti, P., Angel, D.L., Marino, G., Nhhala, H., Hamza, H., Carmignac, C. & Fourdain, L. 2019.
General Fisheries Commission for the Mediterranean. Studies and Reviews. No 97.
Rome, FAO.

This guide is a collection of concepts and practical information aimed at facilitating the establishment of allocated zones for aquaculture (AZAs) in the Mediterranean and the Black Sea. It provides detailed information on the process involved in the establishment of an AZA and it is intended as a practical and comprehensive tool to better understand site selection and planning for aquaculture. This publication first provides a brief overview of the international and regional context, and reviews the institutional and legal framework related to AZAs at various levels. Sequential explanations on the AZA establishment process as well as suggestions for the main steps are then presented. The step-by-step approach for the establishment of AZAs takes into account a number of specific aspects, such as geographic information system tools, exclusion criteria and stakeholder participation, the main actors to be involved, the role of relevant authorities in charge of geographical and/or marine aquaculture planning, statutory responsibilities, prevention and resolution of possible conflicts, and decision making. The guide also describes the objectives and contents of AZA management plans and presents the parameters to be used as reference points for the AZA implementation. It is addressed to decision-makers from relevant bodies and administrations, governmental and non-governmental organizations, scientific research institutions, aquaculture producers and fishing communities, as well as other relevant stakeholders involved in aquaculture activities, coastal development, and in the use of the aquatic environment and resources.

The PDF can be accessed directly at: **www.fao.org/3/ca7041en/ca7041en.pdf**
The document card can be found here: **www.fao.org/documents/card/en/c/ca7041en**



FAO/GFCM 2019

Toolkit on allocated zones for aquaculture. Benefits, implementation and management.

Rome, FAO.

This toolkit contains a series of factsheets introducing the concept of allocated zones for aquaculture (AZA) and presenting a kit of useful tools for the identification, establishment and management of an AZA. The aim is to share existing knowledge on AZAs in order to maximize their beneficial effects in the Mediterranean and the Black Sea. The contents of this toolkit are based on the results obtained through the effective implementation of existing AZAs and they are tailored to the specificities of the region. This toolkit is addressed to policy-makers, regulators including marine planners, non-governmental organizations, farmers and producer associations, local stakeholders and to all coastal zones users in the Mediterranean and the Black Sea.

The PDF can be accessed directly at: **www.fao.org/3/ca5736en/CA5736EN.pdf**
The document card can be found here: **www.fao.org/documents/card/en/c/ca5736en**

FAO 2019

Top 10 species groups in global aquaculture, 2017

Junning Cai, Xiaowei Zhou,a Xue Yan, Daniela Lucentea and Camilla Lagana
Rome, FAO.

The latest FAO global aquaculture production statistics record 608 species items (under the ASFIS – Aquatic Sciences and Fisheries Information System – list of aquatic species) that have been farmed in global aquaculture during 1950–2017. Among them, 424 species items were farmed in 2017, with concrete production statistics recorded in the FAO database (compared to 254 species items in 1990). This factsheet examines 2017 global aquaculture production of these 424 species items to identify the top 10 most farmed ASFIS species items (in terms of quantity or value); the top 10 most farmed species groups; and the top 10 species groups in world aquaculture, excluding China. More information about top 10 aquaculture species (groups) at the regional level and national level (for major aquaculture producers) can be found in the supplementary materials to this factsheet.

The PDF can be accessed directly at: **http://www.fao.org/3/ca5224en/ca5224en.pdf**
The document card can be found here: **www.fao.org/documents/card/en/c/ca5224en/**

FAO 2019

Kenya: High aquaculture growth needed to improve food security and nutrition

Junning Cai, Xiaowei Zhou, Xue Yan, Daniela Lucente and Camilla Lagana
Rome, FAO.

The PDF can be accessed directly at: **http://www.fao.org/3/ca4693en/ca4693en.pdf**
The document card can be found here: **www.fao.org/publications/card/en/c/CA4693EN/**

Cultured species fact sheets

Cultured species fact sheet on *Siganus* spp. (Rabbitfishes)

www.fao.org/fishery/culturedspecies/Siganus_spp/en

Cultured species fact sheet on giant gourami (*Osphronemus goramy*)

www.fao.org/fishery/culturedspecies/Osphronemus_goramy/en

CALENDAR OF EVENTS

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APRIL 2020	Inception workshop of EU-funded TRUEFISH project *Dar es Salaam, Tanzania, 23-24 April 2020 – Martinus.VanDerKnaap@fao.org*
	GAD/FAO Blue Economy Conference *Djibouti, Djibouti, 6-7 April 2020 – Information: Mohamed.AwDahir@fao.org*
JUNE 2020	5th Meeting of the Technical Advisory Committee of the Central Asian and Caucasus Regional Fisheries and Aquaculture Commission *Ankara, Turkey, 8-9 June 2020 – Information: Haydar.Fersoy@fao.org*
JULY 2020	Eighth Meeting of the Regional Fishery Body Secretariats' Network. *Rome, Italy, 11-17 July 2020 – Information: Piero.Mannini@fao.org*
	Committee on Fisheries – 34th Session *Rome, Italy, 13-17 July 2020 – Information: Hiromoto.Watanabe@fao.org*

NON FAO EVENTS

MARCH 2020	Association for Aquaculture in Southern Africa *Stellenbosch, South Africa, 24-27 March 2020 – Information:* ***www.aasa-aqua.co.za/conferences/*** *; Martinus.Vanderknaap@fao.org*
APRIL 2020	38th Southern African Development Community - Technical Committee on Fisheries *Dar Es Salaam, 30 March to 2 April 2020. Information:* ***www.sadc.int/***
JUNE 2020	UN Oceans Conference *Lisbon, Portugal, 02-06 June 2020 – Information:* ***www.un.org/en/conferences/ocean2020***
AUG 2020	Our Ocean 2020 *Palau, 17-18 August 2020 – Information:* ***www.ourocean2020.pw/***
NOV 2020	Aquaculture Africa 2020 *Alexandria, Egypt, 28th November to December 2nd, 2020 – Information:* ***www.was.org/meeting/code/AFRAQ20*** *;* *Blessing Mapfumo, E-mail: Africanchapter@was.org*
DEC 2020	World Aquaculture 2020 *Singapore, Singapore, 14-18 December 2020* ***– www.was.org/meeting/code/WA2020***

FAN

FAO Aquaculture Newsletter

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Food and Agriculture Organization of the United Nations
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E-mail: FIAA-Branch-Head@fao.org

ANNOUNCEMENT

GLOBAL CONFERENCE ON AQUACULTURE 2020

AQUACULTURE FOR FOOD AND SUSTAINABLE DEVELOPMENT

26-30 October 2020
Shanghai, China

Food and Agriculture Organization of the United Nations | SUSTAINABLE DEVELOPMENT GOALS

中华人民共和国农业农村部
Ministry of Agriculture and Rural Affairs of the People's Republic of China

Network of Aquaculture Centres in Asia-Pacific

MESSAGE FROM THE GCA SECRETARIAT REGARDING THE CORONOVIRUS (COVID-19) OUTBREAK

As this issue of FAN is being published, many countries are facing the severe challenge of the COVID-19 pandemic. The health and wellbeing of all GCA 2020 participants is the first and foremost priority of the GCA organizers. We are in regular contact with relevant health authorities and follow closely the guidance of the World Health Organization. For the time being and until further notice, the preparations for the GCA continue as planned but please make sure to regularly consult the website **www.aquaculture2020.org** for updates.

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

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