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# EDITORIAL



# Blue Transformation: Aquaculture in action

In 2022, FAO published the Blue Transformation Roadmap (FAO, 2022), which recognizes the importance of aquatic food systems as drivers of food security and nutrition, employment, economic growth, social development, and environmental recovery: all of which underpin the Sustainable Development Goals (SDGs). It recognizes the need to support the 2030 Agenda through a transformation to more efficient, inclusive, resilient and sustainable aquatic food systems for better production, better nutrition, a better environment, and a better life, leaving no one behind.

The Blue Transformation Roadmap identifies three objectives:

- → Sustainable aquaculture intensification and expansion satisfies global demand for aquatic food and distributes benefits equitably.
- → Effective management of all fisheries delivers healthy stocks and secures equitable livelihoods.
- → Upgraded value chains ensure the social, economic and environmental viability of aquatic food systems.

There are various pathways for intensification and expansion of sustainable aquaculture, implemented through many different innovative approaches and practices. On **aquaculture expansion**, there are many innovative ways in which aquaculture may develop, as follows:

→ Expanded area: Aquaculture development today is imbalanced and there are multiple opportunities for the expansion of aquaculture in less developed areas with suitable natural resources, particularly in Africa, and specifically in areas not otherwise farmable such as arid zones, alkaline land or open oceans.

- → Diversified species and systems: Where aquatic food is a traditional part of diets for indigenous groups, there are needs to farm more local species for their food supply, especially when yields from capture fisheries is declining. There is also scope for the integration of rice and fish systems which contributes to nutrition sensitive food systems, as well as a case for diversified aquatic food (from algae to animals) according to the place of the species in the aquatic ecosystem, through enriching food production at each trophic level, in order to satisfy food supply needs and deliver ecological benefits.
- → Aquaculture for environmental restoration: Due to a range of anthropogenic effects, some aquatic ecosystems are poorly managed or have suffered significant deterioration. Aquaculture may provide an effective approach for environmental restoration, such as restocking of economically valuable species, rehabilitation of seaweed and sea grass beds, or restoring shellfish reefs as functional aquatic ecosystems.
- → Aquaculture supported eco-tourism: Integrating eco-tourism with aquaculture can be an effective mechanism for conservation of aquatic ecosystems through diversified business models. This is becoming popular and welcomed in many places, but requires effective planning, policy support, as well as capacity building for the local communities.

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Top: Fish processors sort the fish at the Volma fish farm in the village of Ozerny, Belarus, which delivers about 1 000 tonnes of fresh fish per year. ©FAO/Sergei Gapon – Bottom left: Mohamaya Bagchi, President of the "Sadarpur Fish Farming in Paddy Fields" community based organization in Sunamganj, Bangladesh. ©FAO/Saikat Mojumder. – Bottom right: Young woman poses for a portrait with a bowl of sea cucumbers from her farm in Misamis Occidental, Philippines. ©FAO/David Hogsholt.



On **aquaculture intensification**, there are various options to intensify farm operation, such as:

- → Aquafeed supply and management: Improved formulation and precise feeding practices, as well as reduction in fish meal and fish oil in favour of alternative ingredients, have led to major decreases in feed conversion rations and the "fish in fish out" ratios. Overall, more production is now possible with the same amount of feed ingredients as a result of these and similar feeding innovations.
- → Modern technology and digitization: Modern technologies such as Artificial Intelligence are applied widely in aquafarms, not only for recirculating aquaculture systems but also open systems. These technologies can enable real-time and automatic responses to changing conditions, monitoring and controlling feeding, aeration, water temperature and water quality. Optimizing the culture conditions can intensify growth by removing inefficiencies in the production environment, and support detailed record keeping, operational logs and support traceability systems.
- → Quality seed supply and genetic resource management: Quality seed is fundamental for aquaculture development; genetic improvement programmes have been established for several high value species, but the same is needed for lower value species such as carps, tilapias and catfish which are critical to food security. There is significant scope for enhancing production efficiency through breeding for farmed types that are better-adapted to the culture systems.
- → Farm management: Programmes for building aquaculture resilience and empowerment of small scale farmers, such as cooperatives, clusters and aquaparks, greatly supported the community aquaculture and industrialization; Some, which were developed in response to the COVID-19 pandemic, can recover production by avoiding losses due to

shocks. These activities include: farm design and operation protocols, insurance schemes, business planning, and risk management plans.

- → Effluent management: Effective management of farm effluents, along with associated legislation and policies, is an integrated part of modern aquaculture, which prevents negative environmental impacts. There are innovative farm designs equipped with in-pond and on-dyke purification units or use of probiotics. Moreover, the combination of fish farming with other production systems, such as integrated agriculture aquaculture or aquaponics, uses circular economy principles to recapture and efficiently reuse wastes as a resource.
- → Energy management: As modern aquaculture often has high energy consumption, it must be considered in order to avoid competition for limited energy resources. Solar energy integration, solardriven equipment, energy efficient pumps and storage facilities are available and should be promoted.

Technology, science and innovation will greatly support the development of sustainable aquaculture in support of enhanced food security, livelihoods and economic development. Aquaculture intensification and expansion will contribute more production and enhance the sustainability of the sector. FAO welcomes more creative innovations in support of implementation of the Blue Transformation Roadmap.

> Written by Yuan Xinhua Deputy Director FAO Fisheries and Aquaculture Division, Rome, Italy

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Fish culture in floating cages in Brahmanbaria, Bangladesh.

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Tilapia fish is displayed to be sold in a fish restaurant in Eldoret, Kenya. Tllapia fish is a traditional and popular meal in East Africa region.

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Head of the National Commission for Aquaculture and Fisheries makes opening remarks to the XII Session of the Sub-Committee on Aquaculture.

# A historic Twelfth Session of the COFI Sub-Committee on Aquaculture concludes in Mexico

Without doubt, the Twelfth Session of the Sub-Committee on Aquaculture of the Committee on Fisheries (COFI:AQ) will be remembered as a historic meeting, taking a giant step towards sustainable global aquaculture production. Held in Hermosillo, Mexico, from 16 to 19 May 2023, the Session began with an opening address by the Deputy Director of the FAO Fisheries and Aquaculture Division, a welcome address delivered by Mexico's Secretary of Foreign Affairs, and opening remarks from the Head of the National Commission for Aquaculture and Fisheries, the Governor of the State of Sonora and the FAO Representative in Mexico. This high-level support from senior government officials, and active participation from delegates from around the world, once again emphasized the increasing recognition of the importance of aquaculture to sustainable development.

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Among the most important elements of the Session was the consensus and technical approval of the Guidelines for Sustainable Aquaculture (GSA), marking a critical milestone in the long process of this major work stream. During these final deliberations, delegates and observers discussed essential and fundamental issues related to governance, natural resource management and social aspects in aquaculture, while also highlighting the importance of the GSA for implementing the FAO Code of Conduct for Responsible Fisheries as well as the Blue Transformation Roadmap. Importantly, the Sub-Committee recognized that the GSA constitute a valuable guide for achieving the sustainable development of the aquaculture sector and the Sustainable Development Goals. Now, with the Sub-Committee's approval, the GSA can be presented to COFI in September for its consideration and eventual adoption. But the GSA is not the only reason that the Twelfth Session was so memorable.

For the first time, "women in aquaculture" was a dedicated agenda item discussed by the Sub-Committee and highlighted during a Special Event. Representatives from all regions, including a representative from an indigenous women's group in Mexico, made presentations providing an overview of the situation, concerns, challenges, and expectations for a more gender equitable, balanced and inclusive aquaculture sector. They also emphasized how all over the world, even though the context and details may be different, there are common themes, common concerns and common hopes. Members then provided detailed and ambitious recommendations to FAO, including exploring the creation of a working group and network on Women in Aquaculture and actions to improve gender-disaggregated statistical information.

The third substantive agenda item was on the cultivation of algae, including macro and micro algae, and its contribution to global aquaculture production. Algae

aquaculture contributes to food security, job creation and economic development. Members and observers recognized the role played by the seaweed-farming sector at global level and emphasized the importance of ecosystem services associated with algae production, including the enhancement and management of biodiversity, restoration of aquatic ecosystems, adaptation and mitigation to climate change, and bioremediation.

Overall, the Twelfth Session was a big success and Hermosillo will be fondly remembered by all those present not only for the site of the approval of the GSA, but also for the warm welcome and kind hospitality of the government and people of Mexico.



Special event on women in aquaculture: challenges and opportunities, at the XII Session of the Sub-Committee on Aquaculture.

### **Related news**

COFI on Aquaculture: Historic session supports efforts towards a sustainable sector

FAO leads global efforts to strengthen aquaculture for food and sustainable development

COFI: Working together for sustainable development of aquaculture

Photos of the Twelfth Session are available on a Flickr album here

https://www.flickr.com/photos/faomexico/ albums/72177720308385191

### Two videos of the event are available on CONAPESCA's YouTube channel here

www.youtube.com/watch?v=d7yIB\_cOw6I

www.youtube.com/watch?v=k3IVVOtI\_ZQ

All documents from the Session are available here

https://www.fao.org/about/meetings/cofi-sub-committeeon-aquaculture

# Guidelines for Sustainable Aquaculture: Where do we stand?



Lopez Jaena, Misamis Occidental, Philippines – Gerry Y. Pepania, 25, feeds the bangus (milkfish) in the «Norwegian style» fish cage that he is the caretaker of in the Mariculture Park off the shore of Barangay Biasong in Lopez Jaena.

The Committee on Fisheries (COFI) in 2018 endorsed the recommendation made by its Sub-Committee on Aquaculture (COFI:AQ) in 2017 that FAO should develop global Guidelines for Sustainable Aquaculture (GSA) to guide government authorities and policy-makers in their efforts promoting the implementation of the Code of Conduct for Responsible Fisheries (CCRF) and enable aquaculture to play a prominent role in the realization of the 2030 Agenda for Sustainable Development. In response to these requests, FAO developed the draft GSA following extensive consultations with experts<sup>1</sup> and Members.<sup>2</sup>

With the aim of having the GSA adopted at its 12th Session in 2023, the COFI:AQ at its 11th Session in 2022 recommended the following three-step process:

1. FAO to revise the draft GSA based on the recommendations of its 11th Session;

## Writtten by:

Elisabetta Martone

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- 2. FAO to share the revised draft with all Members for their written inputs; and
- 3. FAO, together with the COFI:AQ Bureau, to establish a dedicated Task Force, comprised of interested Members including representatives from each region, in order to finalize the draft GSA prior to the 12th Session of the Sub-Committee.

In response to this recommendation, which was endorsed by the 35th Session of COFI, FAO produced a revised draft of the GSA, shared it with Members for their written inputs, and organized a Task Force meeting to discuss these revisions. The Task Force Meeting for the Finalization of the Guidelines for Sustainable Aquaculture was held virtually from 9 to 11 January 2023. The Task Force consisted of representatives appointed by 46 Members: a total of 58 representatives participated in the meeting: 14 from Africa; 14 from Asia and the Pacific;

<sup>1.</sup> The first expert consultation was held in Rome, Italy, from 17 to 20 June 2019. The second expert was held virtually from 18 to 22 October 2021.

Seven regional consultations were held for Africa, Asia, Latin America, Pacific and the Caribbean, Eastern Europe and Central Asia, Near East and North Africa, and Europe and North America.



Sibutad, Zamboanga del Norte, Philippines – An aerial photo of a bangus (milkfish) fish cage off the shore of Canim (sometimes spelled Kanim), Sibutad.

13 from Europe and Central Asia; 9 from Latin America and the Caribbean; 6 from Near East and North Africa; and 2 from North America. The objective of the meeting was to review and finalize the revised draft GSA taking into consideration the written input received by Members.

The meeting was opened by Mr Xinhua Yuan, Deputy Director of the Sustainable Aquaculture Area of the FAO Fisheries and Aquaculture Division, who welcomed the participants and highlighted that the guiding principles of the FAO's Blue Transformation Roadmap 2022–2030 will also be applied to the GSA.

The Task Force elected Mr Edgar Edmundo Lanz Sánchez (Mexico) as Chair, alongside Mr Wenbo Zhang (China), Mr Reinhold Hanel (Germany), Mr Dawood Al Yahyai (Oman), Mr Nazael Amos Madalla (United Republic of Tanzania) and Ms Kristine Cherry (United States of America) and as Vice-Chairs.

The Task Force reviewed the revised draft GSA section by section, discussing the written inputs as received by Members and Non-State Actors, and provided comments. By the end of the meeting, The Task Force agreed on general recommendations to finalize the draft GSA, which included to:

- $\rightarrow$  revise its structure, ensure consistency and coherence;
- $\rightarrow$  shorten the overall length;
- → review and harmonize terminology;
- → align the document with current FAO and other internationally-adopted documents;
- → revise the text on issues for which there were diverging views between Members;
- $\rightarrow$  make the draft GSA more action-oriented;
- $\rightarrow$  identify the target audience for each action; and
- → develop a summary of recommended actions in the form of a policy brief targeted at policymakers (after the adoption of the GSA).

The Task Force also agreed on a roadmap for the finalization of the draft GSA:

- → FAO to produce the revised draft GSA based on the recommendations of the Task Force;
- → the Task Force to revise the document;

- $\rightarrow$  FAO to finalize the document; and
- → FAO to post the final document online one month before the 12th Session of COFI:AQ.

At the 12th Session of COFI:AQ, which was held in Hermosillo, Mexico from 16 to 19 May 2023, the delegates reached consensus on technical approval and recommendation of the GSA to be put to the COFI.



Pudimadaka, Andhra Pradesh, India – Nalla Gauri 45, disperses feed across the pond from a boat at a shrimp farm.

### **SEE ALSO**

**FAO.** 2023. GSA - Guidelines for Sustainable Aquaculture. In: *FAO In Action* [online]. Rome. [Cited 30 May 2023]. www.fao.org/in-action/gsa/en/

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# Members endorse next steps on FAO-developed resources for enhancing management of aquatic genetic resources

FAO's work on aquatic biodiversity for food and agriculture is carried out under the mandate of the Commission on Genetic Resources for Food and Agriculture (the Commission). The Intergovernmental Technical Working Group on Aquatic Genetic Resources (Working Group) is a subsidiary body of the Commission that meets biennially and deals with sector specific issues. It met for its Fourth Session, in Rome, from 21 to 23 February 2023. The meeting, the first to be held in person since 2018, was attended by 52 participants, representing a total of 31 countries, of which 18 countries were those elected as Members of the Working Group for this session and the remaining 13 attended as Observers.

The meeting discussed both sector specific and cross sectoral issues. The Members welcomed the progress reported by FAO on a range of issues related to the implementation of the *Global Plan of Action for the Conservation, Sustainable Use and Development of Aquatic Genetic Resources for Food and Agriculture* (Global Plan of Action) which was adopted by the FAO Council in December 2021 and published in all UN languages (FAO, 2022a). The Working Group recognised, welcomed and provided advice on the initiatives being taken by FAO and by countries including:

- → the release of the prototype version of AquaGRIS, the new global information system on aquatic genetic resources (AqGR), and the progress on the development of its full version.
- $\rightarrow$  the development of a glossary of terms related to AqGR.
- → the development of guidelines on *ex situ in vitro* gene banking.
- → the development of guidelines on genetic management for stocking programmes.
- → the publication of three case studies on management of AqGR (FAO, 2022b-d).

FAO highlighted the progress of the development of a final version of AquaGRIS following the release of its prototype in 2022. The development of the full version is nearing completion and has been expanded to incorporate information on wild stocks of aquaculture species

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**HGURE 1** – The number and spread of resource and process indictors proposed for the monitoring of the implementation of the Global Plan of Action via assessment of progress towards goals associated with its strategic priorities (SPs).

where the prototype focused only on farmed types. The information on wild relatives that AquaGRIS will contain was identified in consultation with a group of experts on management of aquatic species.

The Working Group also considered a second sectorspecific agenda item, discussing the development of indicators for implementation of the Global Plan of Action. At present, there are no accepted indicators of the status of aquatic biodiversity, whether at a national, regional or global level. This is partly a consequence of the fact that, until recently, there has been scarce information available about AqGR below the level of the species. Key information is now being made available, initially through a global assessment of the status of conservation, sustainable use and development of AqGR (FAO, 2019) intended to be repeated every ten years, and more recently through AquaGRIS. FAO has proposed a suite of indicators that can be used to assess progress made by countries in implementing the Global Plan of Action at a national level. Two types of indicators were proposed: resource indicators that relate directly to the status of the genetic resource itself and that can be generated from data in AquaGRIS, and process indicators that will be derived from a purposemade questionnaire that will be completed by national focal points. Overall, a total of 43 indicators are currently proposed, covering 17 of the 21 strategic priorities (SPs) of the Global Plan of Action (see Figure 1).

It was proposed that countries update the information in AquaGRIS every two years. FAO, countries and stakeholders could then generate reports on the resource indicators every two years to monitor progress on the implementation of the Global Plan of Action. FAO would thus produce a summary report for each session of the Working Group. It was further proposed to submit a process indicator questionnaire to countries every five years. Given that the production of a global assessment is intended once per decade, the reports on resource indicators and process indicators would feed into the preparation of said 10-year global assessment, as illustrated in **Figure 2**. This





will reduce the reporting burden for the preparation of country reports for the global assessment by spreading the data collection activities more evenly over time.

The Working Group recommended that FAO hold further consultations with national focal points and other stakeholders to finalise the indicators and the proposed monitoring timeline and these consultations are to be held over the next twelve months. Once integrated into AquaGRIS and once countries have uploaded information on their AqGR into the information system, the indicators will, for the first time, create the opportunity for AqGR to be considered in monitoring the impact of other global instruments such as target 2.5 of the Sustainable Development Goals and the Kunming-Montreal Global Biodiversity Framework. FAO will actively explore the opportunities for such inclusions.

The Working Group also considered a range of crosscutting issues including the role of AqGR in mitigation and adaptation to climate change, access and benefit sharing and digital sequence information, as well as reviewing the strategic plan and the programme of work for the Commission. The full report of the Fourth Session of the Working Group is available online (FAO, 2023).

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FAO. 2022c. Proactive approach proved key to survival for the Australasian Pacific oyster industry. Rome. Also available at: www.fao.org/3/cc3596en/cc3596en.pdf

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Fresh fish for sale at a local market.

# Expert Workshop on "Incorporating Information on Wild Relatives of Aquaculture Species into an Information System for Aquatic Genetic Resources"

FAO held a virtual expert workshop 2–3 August 2022 with 19 participants including experts, facilitators, and FAO staff members. The workshop discussed the expansion of the FAO Aquatic Genetic Resources Information System (AquaGRIS) in order to also include information on wild relatives (in other words wild stocks of aquaculture species).<sup>1</sup> The development of AquaGRIS is supported by a project funded by Germany and, while a prototype has already been released,<sup>2</sup> the fully functional global information system for regular reporting and monitoring by countries will be released in 2023. This meeting was organized in order to consult experts on the effective inclusion of information on wild stocks into AquaGRIS, which will be incorporated during the final phases of its development.

Motivation for discussion of this topic arose from the awareness that wild stocks represent an important reservoir of genetic diversity for aquaculture and, for some species, a direct source of broodstock and seed. In addition, aquaculture can impact wild stocks in numerous ways, both negative and positive, including genetic contamination from escapes and releases. Knowledge of the genetic status of both farmed types and wild stocks will enable effective assessment of, and the development of indicators for, genetic interactions between cultured and wild stocks.

Some key outputs from the workshop included:

- → development of a list of stakeholders for the gathering and utilization of information on wild stocks;
- → ranking of identified stakeholders and identification of the key stakeholders who will benefit from the availability of this information in AquaGRIS - resource managers, policy makers and regulators, aquaculture producers (including broodstock and seed collectors), conservation groups and research, academia, educators and students, were identified as the highest-ranking beneficiaries from such an initiative;
- → creating a working definition of "wild stocks", which would only include cultured species and be limited to self-replicating stocks and thus exclude those sustained by stocking of farmed types;
- → identifying that the main target for data collection should be "genetic stock", identified as:

# Written by:

Graham Mair Daniela Lucente Emma Hemmerlé FAO Fisheries and Aquaculture Division, Rome, Italy Having one or more distinguishing and heritable characteristics that distinguish the wild stock from other wild stocks of the same species within the country (FAO, 2023, p. 8);

- → identifying that a secondary level of classification should be whether a genetic stock is also part of, or corresponds with, an identifiable management or assessment unit (such as a conservation stock or a fisheries stock) and thus subject to some form of management or assessment;
- → identifying potential sources of information on wild stocks and/or mechanisms for its collection;
- → identifying questions to be added to AquaGRIS at the level of species, management/assessment unit, and genetic stock; and
- → identifying potential indicators of the genetic status of wild stocks.

The workshop was successfully concluded, and the outputs of the workshop are being incorporated into the updated AquaGRIS questionnaire that will be used by countries upon the release of the full version of AquaGRIS to report information on both their farmed and wild aquatic genetic resources. FAO is grateful to all the participants for the input that they provided. A published report of the workshop is available.

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1. www.fao.org/aquatic-genetic-resources/activities/aquagris/en/

2. www.fao.org/fishery/aquagris/home

# oal aquaculture updates

# The Eighth Global Conference on Gender in Aquaculture and Fisheries

**W** haping the future: Gender justice for sustainable  $\bigcirc$  aquaculture and fisheries" was the powerful theme chosen for the Eighth Global Conference on Gender in Aquaculture and Fisheries (GAF-8), which bluntly announces that the sector needs to be rethought to achieve sustainability. GAF-8 was held from 21-23 November 2022 in Kochi, India, and was jointly organized by the Gender in Aquaculture and Fisheries Section (GAFS) of the Asian Fisheries Society (AFS), the Indian Council of Agriculture Research - Central Institute of the Fisheries Technology (ICAR-CIFT), and the Society of Fisheries Technologists (India) (SOFTI). Mr Arif Mohammed Khan, Governor of Kerala Shri, inaugurated the conference in the presence of internationally renowned professionals and gender champions including Dr Meryl Williams and Dr George Ninan.

This landmark conference, which seeks to explore the expanding horizons of gender dimensions in aquaculture and fisheries, was attended by approximately 300 academic, gender experts, policymakers and scientists who gave their presentations over three days. In addition, delegates from 20 countries presented papers during the conference, which featured six central themes, ten special sessions organized by international and national organizations, and two special events.<sup>1</sup>

The Food and Agriculture Organization of the United Nations (FAO) was represented by Ms Jennifer Gee, Fishery Officer and Gender Focal Point of the Fisheries and Aquaculture Division, Rome, who delivered an inaugural Special Address and chaired the Special Session 1: "Women and the Changing Tide: Breaking the Bias in Small-scale Fisheries and Aquaculture in the context of IYAFA 2022".

# Breaking the Bias: a fundamental step towards the changing tide and shaping the future

The International Year of Artisanal Fisheries and Aquaculture (IYAFA) 2022 was pivotal in many respects,

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The IYAFA 2022 "Women and a Changing Tide" panel members and audience after the event.

not least with regard to Gender Equality and Equity, Pillar Five of the Global Action Plan and enshrined in IYAFA's vision statement and key messages (FAO, 2023).

Various regional events were organized worldwide under the special initiative of the IYAFA Gender discussion series, which culminated in the special session on Asia organized by FAO at GAF-8, with a discussion panel strengthened by perspectives from Japan, the Philippines, and Thailand.

Maria Cecilia Pastores (FAO Philippines) presented on ongoing projects in the Philippines and discussed the baseline findings in the context of equal rights, access to and control over resources for women and men in smallscale fisheries and aquaculture. The projects also strive to allocate the equal rights and access of women and men to services, market, and decent work conditions for better livelihoods and improving living conditions at sea. Studying the gender dimensions of the value chains, including the gendered division of labour and the gender-based constraints was strongly highlighted as an essential step to break the bias against women's roles in the sector. The way forward is to continue promoting the value of work in all fisheries value chain and strengthening capability of local people for their livelihood.

Still within the region, FAO has been collaborating with the Southeast Asian Fisheries Development Center (SEAFDEC) on a number of gender initiatives and Jariya Sornkliang (SEAFDEC) presented some of their gender-focused work and discussed projects and trainings delivered in the context of equal rights and access to services, markets and decent work. The Philippines is one of the seven countries currently participating in a global project on "Implementing the Small-Scale Fisheries Guidelines for gender equitable and climate resilient food systems and livelihoods." A baseline mapping of women involved in fishing was conducted in project sites to provide a snapshot of the existing situation of women actors along the small-scale fisheries (SSF) value chain as well as those in positions that worked with SSF and projects and programmes to empower women in their livelihood activities. This will form a basis for local program planners

<sup>1.</sup> For more information, please see: www.gafconference.org

to design interventions among women in the SSF value chain.

Yuki Chidui spoke of her experiences throughout her career and entrepreneurship as a woman in a male-dominated field through the lens of equal voice and decision-making power (see an interview with Yuki on page 42 of this issue of FAN). She worked as a manager at Nadeshiko Sushi in Akihabara, Tokyo, Japan for ten years and founded a sushi school where she teaches students, especially women, how to excel as sushi chefs. In 2021, she founded the Next Generation Sushi Association, which is dedicated to the promotion of free-style sushi without being bound by stereotypes, permanent job security for women, expansion of new career choices, and education and training for the children who will be the leaders of the future. Ms Chidui established BKTC Inc. in January 2022 and started her own aquaculture business. Her experience as a female sushi chef was pivotal in developing and marketing her business and evidences a rare women-led endeavour in the Japanese fisheries industry.

The panel discussions identified a lack of women in leadership positions as well as a lack of voice and agency in the decision-making process. The discussions shed further light the need for breaking the gender bias in small-scale fisheries and aquaculture. The panellists noted that it is not enough to just showcase the centrality of women in small-scale aquaculture and fisheries, it is also essential to work and push towards food systems where women and men have equal voice and decision-making power. Efforts must also be undertaken to ensure that women and men have equal rights while gaining equal access to, benefit from, and control over resources.

Achievement of the SDG14 is an objective that will remain challenging if gender equality is not effectively embedded as a main driver for change or transformation, especially in terms of access to resources and markets (14.b). "Breaking the bias" is also a matter of equal rights, and international commitment can and must pave the way for ensuring that women and men have equal rights, access to services, markets, and decent work in a way that aims to empower women and men more effectively throughout the value chains of fisheries and aquaculture. In addition, women's triple burden must be relieved by not only improving access to technology, practices, and infrastructure, but also by addressing unpaid domestic work and caregiving at the household and community levels.

# International commitment and partnerships to accelerate the changing tide

For decades, researchers, women's groups and fisheries and aquaculture professionals have been leading the fight against gender inequality and discrimination that hurts the entire sector. Networks of gender champions have multiplied, and their advocacy has met with FAO's commitment to promote gender equality, which stems from the intergovernmental mandate of the United Nations, to promote and protect women's rights as fundamental human rights. Indeed, the Organization clearly states that gender equality is essential to achieve its mandate of a world free from hunger, malnutrition and poverty and



The IYAFA 2022 "Women and a Changing Tide" panel members and special guests after the event.

recognizes that persisting inequalities between women and men are a major obstacle to agricultural and rural development (FAO, 2020).

While international commitment is fundamental to tackling this persistent and pervasive human rights issue, it is also crucial to develop partnerships between different sector stakeholders to tangibly shape an inclusive and equitable future.

The FAO Fisheries and Aquaculture Division has activated this commitment by appointing the Gender in Aquaculture and Fisheries Section (GAFS) of the Asian Fisheries Society as an Observer to the Committee on Fisheries and its Sub-Committees on Aquaculture and Fish Trade. In the same spirit of strengthening collaboration, FAO was invited to GAF-8.

Finally, for the first time in its history, the Twelfth Session of the Sub-Committee on Aquaculture held a Special Event dedicated to Gender Equality and Women's Empowerment: "Women in Aquaculture – Challenges and Opportunities". The Special Event was timely, further emphasizing on the importance of gender in the sustainable aquaculture agenda and highlighting, through regional presentations, that while the contexts around the world might differ the core issues are very similar.

Between GAF-8, strengthened collaboration with GAFS and the upscaling of gender in the sustainable aquaculture agenda, significant progress is expected in shaping the future towards gender justice in aquaculture.

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Aquaculture 2022 – Final report. Rome. Also available at: www.fao.org/3/cc5034en/cc5034en.pdf

# Pathway to aquaculture biosecurity: Mitigating risks, managing progressively and engaging the value chain

"Management of aquatic organism health by national, regional, international and multistakeholder cooperation is necessary to sustain the growth that has been achieved" – a resolute appeal for global action made at the turn of the Third Millennium, barely 25 years since aquaculture was recognized as an industry sector. To ensure they were not ignored, "Management of Aquatic Animal Health" was enshrined in the Strategy for Aquaculture Development beyond 2000 adopted by the Conference on Aquaculture in the Third Millennium in 2000 (FAO, NACA, 2000) and reinforced in the two global aquaculture conferences that followed (Phuket 2010 and Shanghai 2020) (FAO/NACA, 2012; FAO, NACA, 2021).

As health management gained relevance and urgency, two essential pillars were introduced by FAO, WOAH, NACA, and industry and academic partners: risk management and aquatic biosecurity. These and the other components of aquatic organism health strategy have now converged into the novel initiative "Progressive Management Pathway for Aquaculture Biosecurity" (PMP/AB).

### Rising output and the rise and spread of diseases

World aquaculture output, from the first estimate of six million tonnes a year in 1975, had reached 126 million tonnes (worth USD 296.5 billion) by 2021 (FAO, 2023). By the 1990s, however, the emergence and spread of new and other persistent diseases began to cause concern to farmers, traders, governments, scientists, international technical organizations, and assistance agencies that these diseases were slowing the growth of the sector. Concerns focused on three issues:

- 1. *Increasing numbers, frequency, spread, severity and persistence of diseases.* Important cultured and wild aquatic species are affected.
- 2. Increasing costs to the industry. As damage became widespread from production loss, vanished value addition, lost employment opportunities, and the cost of disease control, measures soared. By the second decade of the millennium, it was reported that industry-wide losses caused by diseases of aquatic organisms exceeded USD six billion a year.
- 3. *Time lag from detection of an outbreak to development and deployment of control measures.* The damage to the industry accrues and the costs pile up during this time. Three or more years can pass between the disease being detected and the placement of control measures. For example, Acute hepatopancreatic necrosis disease

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Good husbandry and biosecurity practices can produce healthy and resilient farmed aquatic species.

inflicted a loss in shrimp production of USD 12 billion from outbreak to implementation of a control (Shinn *et al.*, 2018).

Magnifying these concerns is the overriding need to sustain the livelihoods of millions working along the aquaculture value chain and to ensure the food security and nutrition of over eight billion people.

### Disease emergence drivers, factors and pathways

The fundamental strategy of the PMP/AB is prevention, enabled by risk management. This makes it imperative to understand the drivers, factors and pathways to aquatic disease emergence.

The following is an overview of the analysis of three important factors made by experts prior to the development of the PMP/AB.

### **Aquaculture biosecurity**

The analysis reflects the barriers and complex challenges to carrying out the mandate from the Millennial conferences. Surmounting them depends on the sector arming itself with one basic capacity: aquaculture biosecurity. In the context of the PMP/AB, aquaculture biosecurity is 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. Its key elements are risk management, a multi-level geographical coverage and value chain approach, and multi-stakeholder collaboration and collective responsibility.

# The special challenge

Compounding the institutional shortcomings in aquaculture biosecurity is the difficult technical/environmental challenge posed by the culture medium. Monitoring growth and keeping optimal water parameters are difficult enough. Preventing the introduction and monitoring the presence of pathogens in the surrounding and culture waters, avoiding water contamination, and reducing susceptibility

# Drivers, factors and pathways that contribute to aquatic disease emergence

- 1. AQUATIC HEALTH MANAGEMENT AND DISEASE CONTROL: multiple institutions involved; inadequate or poorly implemented biosecurity measures and low capacity for emergencies; perceived low incentive to report on known and emergent diseases; weak regulatory framework and lack of an effective public-private sector partnership (PPP).
- 2. TRADE OF AQUATIC ORGANISMS: highly traded commodity (70% exposed to international trade); live animals (larvae, fry, adults) and their products (live, fresh, frozen) globally traded; invasive animals are traded and pathogens carried by the primary host.
- 3. KNOWLEDGE OF PATHOGENS AND THEIR HOSTS: unique aquatic medium; for unknown and even known diseases, there remained significant knowledge gaps regarding transmission, immunity and genetics; diagnostics focused on known/listed diseases; breeding strategies not in place for many species; not easy for farmers to obtain efficacious and affordable vaccines.
- 4. ECOSYSTEM CHANGE: physico-chemical conditions in aquaculture are often sub-optimal for host; aquatic hosts are cold-blooded, thus highly vulnerable to stressors; the aquatic medium is pathogen-rich, diversity changes with environment conditions; pathogens evolve and spill-over and spill-back relative to wild populations.

to infection by mitigating stress-related impacts on the culture environment make aquaculture biosecurity much more complicated.

# PMP/AB: a new way to handle the challenges

The PMP/AB aims to enhance aquaculture biosecurity capacity at the regional, national, local sector and enterprise levels. To do so, it builds on:

- → existing institutional and legal frameworks, capacity and appropriate tools, using risk-based approaches and PPP; and
- $\rightarrow$  resilience to the biosecurity vulnerabilities.

Developed in two multi-stakeholder consultations and several Technical Working Group meetings (FAO, 2020), and endorsed by FAO's Committee on Fisheries Sub-Committee on Aquaculture (Tenth, Eleventh and Twelfth sessions), the PMP/AB is expected to sustain:

- $\rightarrow$  a reduction in disease burden;
- $\rightarrow$  an improvement of health at farm and national levels;
- $\rightarrow$  a minimization of global spread of diseases;
- → an optimization of the socio-economic benefits from aquaculture;
- → an attraction of investment opportunities into aquaculture; and
- → an achievement of the One Health goals health of the ecosystem, people, and cultured organisms.

The PMP/AB will, therefore, contribute to SDG2, "Zero Hunger"; SDG 3, "Good health and well-being"; SDG 6, "Clean water and sanitation"; and SDG 14, "Life below water".



Diversity of aquaculture systems and environments produce diverse aquatic foods.



# How to join, practice and progress along the Pathway

A comprehensive guide to entry and execution is provided by the Progressive Management Pathway for Aquaculture Biosecurity (PMP/AB): guidelines for application (guidelines) (FAO, forthcoming). The guidelines illustrate (see figures below) and explain the pathway's four stages:

- 1. biosecurity risks defined
- 2. biosecurity systems initiated
- 3. biosecurity systems and preparedness enhanced
- 4. sustainable biosecurity and heath management systems established.

Three principles guide every stage:

- 1. risk-based
- 2. collaborative
- 3. progressive, with a good understanding of the epidemiological triad.

The triad portrays the relationship between a *pathogen* and susceptible aquatic *population* in a suitable *environment* that allows transmission of the pathogen and development of disease in the population. Understanding the relationship between host, pathogen and environment affected by human actions is key to the implementation of the PMP/AB.

Risk assessment and emergency preparedness are carried out in every stage. Each stage has key indicators and activities. The five objectives of each stage are attained through five outcomes, whose satisfactory achievement allows the country to progress to the next stage. The four stages including the overall objectives and key outcomes to complete each stage; the details of each outcome; the recommended activities to produce each outcome; and a flowchart of the process and activities to complete Stages 1, 2 and 3 are described in the guidelines.

Practical guidance can also be drawn from three ongoing applications in three sectors: Seaweed, which covers all cultured seaweed species (Cottier-Cook, *et al.*, 2022); Shrimp, which can be applied by the country, sector or an enterprise (Bondad-Reantaso, *et al.*, 2022); and Tilapia, which adopts a value chain approach (MacKinnon *et al.*, 2023). More guides and tools to get started and progress through the pathway are cited in the guidelines.



SFAO/P. Padre

Padre

Factors, drivers and pathways to aquatic disease emergence in aquaculture.



# **Benefits**

The mutually reinforcing benefits accrue to a country, the industry, the farms and the enterprises along the PMP/AB. Briefly these are:

→ Better governance: It offers countries the opportunity to harness aquaculture production that is responsive to environmental and human-induced challenges and requires enabling policies.

# → Partnership, shared ownership and responsibilities: It provides a solid platform for public-private partnerships, through the formulation of strategic and implementation plans that are jointly developed by industry stakeholders, governance

authorities and academe. This ensures buy-in and best-fit for each country. → Tangible benefits to stakeholders at every stage:

- This encourages long-term commitment. Co-management principles ensure that problems are well defined and management solutions are identified.
- → Commitment to risk management: It establishes risk ownership and promotes active engagement and long-term commitment to risk management.
- → **Sustainability:** All the above, which can be boiled down to collaboration among the major stakeholders marked by coordinated efforts of various institutions and experts; pooling resources, sharing knowledge, expertise and experiences; cooperation and goodwill; and the sustainability of the biosecurity component of aquaculture management and the global aquaculture industry.

These specific benefits include: better risk management, cost-effective mobilization and application of scientific, technical and physical resources, and public confidence on the safety of the products and goodwill engendered by social and environmental responsibility.

# Way forward

The PMP/AB, which now includes aquatic plants, hence the use of the term aquatic organisms covering both plants and animals, is a paradigm shift in the way disease challenges are handled. It is infused with the principle embodied in the timeless adage – "An ounce of prevention is worth a pound of cure." Proactive and preventive biosecurity measures are less expensive than solutionbased, reactive responses to outbreaks. Reducing the time taken to respond to an outbreak is crucial.

The desired outcome is healthy and safe aquatic foods, with reduced disease burden and the achievement of One Health goals, to enhance the food and nutrition security of a growing world population. The broader outcomes are increased investment in the sector; sustained economic benefits for primary stakeholders; and social, economic and environmental benefits for everyone else. To bring these about, aquaculture stakeholders need and are encouraged to take an active role in the PMP/AB, exploring the opportunities for cooperation, partnership and co-ownership –reaping the co-benefits that it offers.

One of the clearest signs of a maturing industry is when the focus is on disease prevention supported by effective governance and innovation.

Countries and aquaculture value chain stakeholders are, therefore, encouraged to embrace PMP/AB and establish biosecurity in parallel with any aquaculture development.

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# FAO at Aquaculture America 2023

The United States Aquaculture Society, formerly a Chapter of the World Aquaculture Society, joined the National Aquaculture Association and the Aquaculture Suppliers Association to convene the annual Aquaculture America meeting 23–23 February in New Orleans. The Aquaculture America conference, themed "Food for the Future," provided a platform for knowledge sharing and exchange regarding the development of global aquaculture.

Tracy Fanara, US Coastal Modelling Manager at the National Oceanic and Atmospheric Administration, and Daisy Berg, from the New Seasons Market, provided the keynote addresses during the opening ceremony titled "A Modern Take on Science Communication" and "Grocery Chain Changes Its Tune to Include Aquaculture", respectively.



A keynote address on the communication of science in the modern world presented to Aquaculture America.

The three-day event had a total of 79 sessions, and featured presentations (both oral and poster) on topics related to finfish, crustaceans, shellfish, engineering, health and disease, nutrition, and reproduction. The event also featured exhibitions on aquaculture equipment, fish seed (broodstock, smolt, fry, egg, larvae), system design, feed (ingredients, additives, processing equipment), health products (probiotics, testing), trade (exporters, importers), veterinary consultations, research, and media services.

FAO delivered two presentations at the "Fish to feed the world: Advancing sustainable solutions for global food security" session of the conference, with one taking insights from Nigeria, Lao People's Democratic Republic, and

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China to answer the question "Can the diversification of rice farming with fish support communities and countries in achieving the Sustainable Development Goals?" and the other focused on "Maximizing nutritional impacts of farm diversification (rice-fish) intervention." The session was facilitated by the Feed the Future Innovation Lab for Fish.

Aquaculture America 2023 was reported to have been the largest aquaculture trade show in the Western Hemisphere and one of the largest anywhere in the world with nearly 200 booths showcasing the latest products, technologies and services in the aquaculture industry.

Aquaculture America 2023 once again provided opportunities for the sharing and exchanging of information on a wide variety of aquaculture issues, and in particular for networking with focus on North American partners. With the regional World Aquaculture Society event in Africa to be held in Lusaka, Zambia in November 2023, it was proposed that FAO take a prominent role in its preparation, possibly in the form of an FAO Special Day as was held in Rimini, Italy in September 2022.



Oluwafemi Ajayi's presentation on maximizing the nutritional impact of a farm diversification (rice-fish) intervention.

# **SEE ALSO**

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# Regional closing event of the International Year of Artisanal Fisheries and Aquaculture in Latin America

The international community fully recognizes the growing importance of small-scale artisanal fisheries and aquaculture as pillars of food production and poverty eradication, both from catches at seas and inland waters as well as those from aquaculture farming systems, to meet the nutrition needs of a growing world population.

Women and men in small-scale artisanal fisheries and aquaculture in Latin America and the Caribbean contribute significantly to food and nutritional security of the population and stimulate local economies (Figure 1).

On the occasion of World Fishing Day, commemorated on 21 November 2021, FAO launched the International Year of Artisanal Fisheries and Aquaculture (IYAFA) 2022 in Latin America and the Caribbean. The event was carried out virtually as the starting point for the celebration of the IYAFA 2022 in the region and was attended by various sectoral actors, including national fisheries and aquaculture authorities, fishers and fish farming organizations, and civil society. The event was very well received and virtual attendance surpassed 1 200 people.<sup>1</sup>

To promote inclusive actions for the IYAFA 2022, three committees were established in Latin America and the Caribbean: Western Central Atlantic Fishery Commission IYAFA 2022 Coordination Committee; the Mesoamerican

1. www.fao.org/americas/eventos/ver/en/c/1450084

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Committee; and the South American Committee, for the Celebration of the IYAFA 2022.

The committees are composed of a wide range of stakeholders, including fishers, fish farmers, fish workers, government representatives and academics. All stakeholders have an equal voice and decisions are made by consensus. Work within the committees is guided by solidarity, environmental and social responsibility, and respect for diversity. The table below summarizes the main achievements of the committees.

Committee	Main achievements			
South American Committee	<ul> <li>three publications on small-scale artisanal fisheries and aquaculture based on surveys and interviews with people involved in fishing and aquaculture in ten countries in South America. These publications adopted a gender-sensitive approach, and include concrete recommendations to strengthen the sector;<sup>2</sup></li> <li>webinar on fish consumption;<sup>3</sup></li> <li>webinar on associativity.<sup>4</sup></li> </ul>			
Mesoamerican Committee	<ul> <li>diagnosis of the social protection status of artisanal fisheries and aquaculture in Mesoamerica;</li> <li>Mesoamerican forum to promote the inclusion of artisanal fisheries and small- scale aquaculture producers in national social protection schemes;</li> <li>agreements in El Salvador with progress regarding the inclusion of fishers in the national social protection schemes;</li> <li>creation of the Mesoamerican network of small-scale aquaculture farmers (REMAPE);</li> <li>regional forum for the exchange of experiences on aquaculture extension in Latin America and the Caribbean;</li> </ul>			

2. www.fao.org/americas/noticias/ver/en/c/1635882

3. www.fao.org/americas/eventos/ver/en/c/1512837

4. www.fao.org/americas/eventos/ver/en/c/1601550



FIGURE 1 – Women and men engaged in small-scale artisanal fisheries and aquaculture in Latin America and the Caribbean

**Top left:** PERU. Restaurant "*La Anchoveta Azul*," in Cerro Azul, province of Cañete, which offers various anchovy-based dishes; **Top center:** BRAZIL. A small-scale mussel farmer from Santa Catarina harvesting his product manually; **Top right:** MEXICO. Boy sells fresh tilapia with his mother, by their farm in lxcatán, Oaxaca, Mexico. In rural areas, it is very common to find boys and girls enthusiastically learning aquaculture in their own family farms. Small-scale aquaculture is of utmost relevance in rural territories, contributing to food security and nutrition, and with positive socioeconomic impacts; **Center:** PARAGUAY. Mr Hilarión Gaona practicing and promoting family fish farming; **Center right:** CHILE. Group of

### Table continued from previous page

Committee	Main achievements
Western Central Atlantic Fishery Commission IYAFA 2022 Coordination Committee	<ul> <li>list of IYAFA champions (individuals and institutions) who exemplify the ideals of the Small-scale Fisheries (SSF) Guidelines and the pillars of IYAFA 2022;</li> <li>support the reactivation and implementation of Colombian indigenous community in producing low-cost alternative diets for cachama fattening;</li> <li>support the development of a regional guidance document on better positioning small-scale fisheries and aquaculture in the regional blue economy dialogue;</li> <li>lead regional youth chats in Jamaica, Guyana, and Saint Lucia to discuss approaches that can support the sustainability of small-scale fisheries via a youth-centric approach;</li> <li>high-level dialogue of the Caribbean Community (CARICOM) fisheries ministers on mainstreaming the contribution of SSF/A in the regional blue economy dialogue during the Caribbean Regional Fisheries Mechanism's 11th Ministerial Council; and</li> <li>hybrid Regional Women in Fisheries Forum at the 75th meeting of the Gulf and Caribbean Fisheries Institute.</li> </ul>

small-scale women seaweed farmers harvesting Sea Chicory (*Chondracanthus chamissoi*) in Caleta Coliumo, Bio bio region; *Bottom left*: PANAMA. Artisanal fishers (Indigenous Peoples) from Guna in northeast Panama; *Bottom center*: ECUADOR. Fishers from San Clemente setting sail into the open sea in search of the ocean currents to launch their fishing nets; *Bottom right*: WEST INDIES. Women play an integral role in artisanal fisheries and aquaculture in the Western Central Atlantic, as fishers, vendors, boat owners, and chief fisheries officers. Recognizing the important role of women was a key motivation behind the selection of Gender and Youth as cross cutting themes in the celebration of the International Year.

The event took place in Puntarenas, Costa Rica on 31 March 2023. It included the participation in person of representatives of 15 of the 21 member countries attending the 18th Session of the Commission of Small-Scale, Artisanal Fisheries and Aquaculture of Latin America and the Caribbean (COPPESAALC) namely; Argentina, Bolivia (Plurinational State of), Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Peru and Uruguay. Different regional fisheries and aquaculture organizations were also represented as accredited observers.

The topics discussed at the event included:

- → an introduction by Alejandro Flores Nava, FAO Senior Fisheries and Aquaculture Officer;
- → welcoming remarks by Desilú León, Vice Minister of Fisheries and Aquaculture of Peru;
- → other effective area-based conservation measures in marine fisheries (OECMs) by Amber Himes-Cornell, FAO Fishery Officer;
- → work achieved by the South American Committee by Marisol Alvarez from Chile and the Mesoamerican Committee by Francisco Javier Martínez Cordero from Mexico;

- → declarations from the South American Committee by Gabriela Cruz Salazar from Ecuador and the Mesoamerican Committee by Francisco Javier Martínez Cordero from Mexico; and
- → closing remarks by Eve Crowley, FAO Deputy Regional Representative for Latin America and the Caribbean and FAO Representative in Chile and Ecuador; Adoniram Sanches Peraci, sub-Regional Coordinator for Mesoamerica and FAO Representative in Panama and Costa Rica; and Heiner Méndez, Minister of Fisheries and Aquaculture of Costa Rica.

The work carried out during IYAFA 2022 created knowledge about sustainable small-scale fisheries and aquaculture in the region, including recommendations to further support the subsector. These include the areas of environmental, economic, and social sustainability; governance; gender equality and equity; food security and nutrition; and resilience.

For the closing ceremony, a photo gallery and one video were produced about a group of fisherwomen from Costa Rica who protect and manage mangroves to sustain their families and protect biodiversity.<sup>5</sup>

The event closed with two Declarations for the IYAFA 2022; one from the Mesoamerican Committee and another from the South American Committee to carry forward the momentum and support generated by IYAFA 2022.<sup>6,7</sup>

Although the IYAFA 2022 celebration has now ended, it represents a new era of support for small-scale artisanal fisheries and aquaculture. The actions generated by the IYAFA 2022 will continue, where efforts will be required to help make small-scale artisanal fisheries and aquaculture more visible in the national development agendas to

- 5. https://www.fao.org/fao-stories/article/en/c/1637265/
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- 7. https://www.fao.org/3/cc5781es/cc5781es.pdf

stimulate their prioritization, the generation of specific policies, and the allocation of the necessary resources for their sustainable development.

Moreover, the promotion of stronger cooperation among the countries in the region and further afield on technical matters and support to small-scale artisanal fisheries and aquaculture operations are key elements to foster investment and help the region gain a solid position among world aquatic food producers.

To further strengthen bonds/interconnectivity for the longterm development of small-scale fisheries and aquaculture for the IYAFA 2022 in the region, the Western Central Atlantic Fishery Commission IYAFA 2022 Coordination Committee plans to hold a closing ceremony as a part of the next Commission's meeting in September 2023.

# **SEE ALSO**

Aguilar-Manjarrez, J., Flores Nava, A., Wade, E. & DieiOuadi, Y. 2022. The International Year of Artisanal Fisheries and Aquaculture in Latin America and the Caribbean: Towards Inclusive, Responsible and Sustainable Fisheries and Aquaculture. FAO Aquaculture News. May 2022, No. 65. Rome. pp. 11–14. www.fao.org/3/cc0158en/cc0158en.pdf

**FAO.** 2023. FAO closes the International Year of Artisanal Fisheries and Aquaculture with public policy recommendations to strengthen the sector. In: *FAO Regional Office for Latin America and the Caribbean*. Santiago, Chile. Cited 9 May 2023. www.fao.org/americas/noticias/ver/en/c/1635882/

FAO. 2023. International Year of Artisanal Fisheries and Aquaculture closes with many concrete results. In: *FAO Fisheries and Aquaculture Department*. Rome. Cited 9 May 2023. www.fao.org/newsroom/detail/IYAFA-2022-closes-with-manyconcrete-results-310323/

**FAO.** 2023. Regional closing Event of the International Year of Artisanal Fisheries and Aquaculture. In: *FAO Regional Office for Latin America and the Caribbean*. Santiago, Chile. Cited 9 May 2023. www.fao.org/americas/eventos/ver/en/c/1634191/

**FAO.** 2022. The International Year of Artisanal Fisheries and Aquaculture. In: *FAO Regional Office for Latin America and the Caribbean.* Santiago, Chile. Cited 9 May 2023. www.fao.org/americas/priorities/iyafa2022/en/



Participants of the Regional closing event of the International Year of Artisanal Fisheries and Aquaculture 2022 in Latin America in Puntarenas, Costa Rica, 31 March 2023.

# Latin American and the Caribbean call to increase the contribution of fisheries and aquaculture to food and nutrition security



The XVIII Session of the Commission of Small-Scale, Artisanal Fisheries and Aquaculture of Latin America and the Caribbean (COPPESAALC) took place in San José, Costa Rica from 29–31 March 2023.

The meeting complies with the provisions of the Commission's statutes regarding the holding of regular biennial sessions. Its objectives are to report the measures adopted with respect to the agreements of the previous meeting; reflect collectively on the issues that concern the sustainability and contribution of fisheries and aquaculture to food security; the alleviation of rural poverty and the responsible and harmonious management of natural resources, in line with the needs of the member countries of the Commission; FAO regional priorities; and the goals of the UN Sustainable Development Agenda.



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FIGURE 1 – Participants of the XVIII Session of the Commission of COPPESAALC. San José, Costa Rica, 29–31 March 2023.

In Latin America and the Caribbean, fisheries and aquaculture, both artisanal and industrial, generate more than 2.8 million direct jobs and three times as many indirect ones. At least 16 percent of the work associated with capture fisheries is in the hands of women, whose work is concentrated in (although not limited to) post-capture activities, according to data from FAO.

The XVIII Session of COPPESAALC provided a key opportunity for all stakeholders to come together to address the challenges facing fisheries and aquaculture in the region and to explore together viable solutions.

The topics discussed at the meeting included:

- $\rightarrow$  measures taken regarding decisions and
  - recommendations to the XVII ordinary session of COPPESAALC;
- → the priorities established by the XXXVII FAO Regional Conference for Latin America and the Caribbean;
- → agreements adopted during the 35th FAO Committee on Fisheries;
- → the state of Marine Fisheries in Latin America and the Caribbean;
- → the state of Inland Fisheries in Latin America and the Caribbean;
- → the state of Aquaculture in Latin America and the Caribbean;
- → Blue Transformation; the Contribution of Regional Fisheries and Aquaculture to FAO's New Strategic Framework;
- → the state of the Port State Measures Agreement to Combat Illegal, Unreported and Unregulated Fishing;
- $\rightarrow$  FAO and marine areas beyond national jurisdiction;

- → Climate Change in Regional Fisheries and Aquaculture: Progress and Setbacks; and
- → results of the workshop on other effective area-based conservation measures (OECMs) in marine fisheries in Latin America and the Caribbean.

The main outcomes of the meeting were the recommendations of COPPESAALC to the 38th Regional Conference for Latin America and the Caribbean (LARC38) to be held in 2024 in Guyana, and the Commission's Work Plan for the biennium 2024–2025 listed below. Panama offered to host the XIX Session of the Commission in 2025.

Recommendations of COPPESAALC to LARC38 which include aquaculture:

- → support efforts of member countries to promote aquaculture extension programs and services with a focus on self-management and empowerment of small producers;
- → promote and support the inclusion of small-scale artisanal fisheries and aquaculture social protection and decent employment systems at the national level;
- → prepare manuals and guidelines for the process of identification, evaluation and notification of other effective area-based conservation measures (OECMs) related to inland fisheries and aquaculture;
- → continue assisting countries in their efforts to adapt to climate change; and
- → support efforts to make small-scale artisanal fisheries and aquaculture sectors more visible in national development agendas to stimulate their prioritization, the generation of specific policies, and the allocation of the necessary resources for their sustainable development.

Recommendations of COPPESAALC for the Commission's Work Plan for the biennium 2024–2025 which include aquaculture:

- → Continue assistance to countries in developing climate change vulnerability analysis in fisheries and aquaculture;
- → Continue assisting countries in promoting aquaculture extension programs and services; and
- → Assist member countries in strengthening smallscale aquaculture, through improving their access to innovation and sustainable technologies that improve their economic competitiveness and their resilience to climate change.

Two events were held within the XVIII COPPESAALC Session and were attended by representatives of the Commission.

# **Conservation measures**

A capacity-building workshop on other effective areabased conservation measures (OECMs) in marine fisheries was held from 27 to 28 March in San José, Costa Rica. This event provided an introduction to OECMs, an analysis of how the criteria for OECMs should be applied in marine fisheries, and a typology of area-based fisheries management measures that could be potential OECMs. It was also an opportunity for collective work to analyze case studies of area-based fisheries' measures from Chile, Costa Rica, Guatemala and Mexico in the context of the OECM definition and criteria as well as to discuss the main challenges found. Follow-up activities on OECMs in the region include one training workshop in Chile in late 2023 and another in Brazil in 2024.

# Regional closing Event of the International Year of Artisanal Fisheries and Aquaculture

The regional closing event of the International Year of Artisanal Fisheries and Aquaculture (IYAFA 2022) in Latin America was held on 31 March in Puntarenas, Costa Rica. The event paid homage to the many women and men involved at all stages of the small-scale artisanal fisheries and aquaculture value chain and to those who contribute significantly to achieving a world without hunger.

Some of the key issues highlighted at the event were the sustainability and contribution of small-scale artisanal fisheries and aquaculture to food and nutritional security; alleviation of rural poverty; gender equality and equity as well as working conditions and access to social protection; and the responsible and harmonious management of natural resources.

The event closed with two Declarations for the IYAFA 2022: one from the Mesoamerican Committee and another from the South American Committee to take forward the momentum and support generated by IYAFA 2022 to further support the subsector.<sup>1,2</sup>



1. www.fao.org/3/cc5782es/cc5782es.pdf

2. www.fao.org/3/cc5781es/cc5781es.pdf

# **SEE ALSO**

**FAO.** 2022. A handbook for identifying, evaluating and reporting other effective area-based conservation measures in marine fisheries. Rome. www.doi.org/10.4060/cc3307en

**FAO.** 2023. XVIII Session of the Commission of Small-Scale, Artisanal Fisheries and Aquaculture of Latin America and the Caribbean (COPPESAALC). In: *FAO Regional Office for Latin America and the Caribbean*. Santiago, Chile. Cited 04 May 2023. www.fao.org/americas/eventos/ver/en/c/1629167/

**FAO.** 2023. FAO closes the International Year of Artisanal Fisheries and Aquaculture with public policy recommendations to strengthen the sector. In: *FAO Regional Office for Latin America and the Caribbean*. Santiago, Chile. Cited 04 May 2023. www.fao.org/americas/noticias/ver/en/c/1635882/

# Aquaculture and rural communities: Farm diversification through rice-fish farming



Rice transplanting at a rice-fish demonstration site in Nigeria.

FAO, together with experts from the University of Ibadan, Nigeria, and the University of Georgia, United States of America, collaborated to implement a farm-diversification project in Nigeria. The project was funded by the U.S. Agency for International Development Feed the Future Innovation Lab for Fish.

The farm-diversification process provided rice farmers with the opportunity to start a new farming enterprise without undermining the expected outcome (yield) of their existing rice production. In the new system, rice farmers modify their fields to produce fish in addition to rice, including knowledge on fish stocking, feeding, best rice-fish coculture management practices, and value-addition (fish smoking).

The new system optimizes the use of available land and water resources for the simultaneous production of two food commodities, rice and fish, in the same production area. This leads to an increase in the amount of food produced per unit area, meaning that more rice and more fish are available both on the table and for the market.

### **Beneficiaries**

The project was implemented in rice-growing communities of Ebonyi and Kebbi states, Nigeria. The intervention

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focused mainly on smallholder farmers. Beneficiaries also included hatchery operators, government extension workers, and graduate students from Nigerian universities who benefitted from training.

### **Rationale for intervention**

Food security and nutrition challenges are widespread across Nigerian states. This is caused by intertwined factors ranging from poverty, lack of nutrition education, knowledge gap in agriculture/aquaculture practices and inefficient market systems. A situation where 35 percent of children under the age of 5 are stunted, an indicator of low weight-for-height as a result of impaired growth and development that children experience from poor nutrition, and 6 percent of them suffer from wasting, low weightfor-height. Furthermore, 12.7 percent of the population, nearly 1 out of 8 people are reported undernourished: Undernourishment is a condition in which an individual's habitual food consumption is insufficient to provide the amount of dietary energy required to maintain a normal, active and healthy life. FAO defines hunger as being synonymous with chronic undernourishment. Ebonyi and Kebbi states are among the states severely affected by food insecurity challenges in Nigeria, with rural poor communities most affected. In order to meet the SDG 2 targets of ending hunger and all forms of malnutrition, intervention actions that will drastically transform food systems to become more productive, equitable, and ensure access to safe, nutritious and sufficient food all year round should be promoted.

The diversification of farming systems to produce more food through integrated agriculture-aquaculture (IAA) systems could play a vital role as an intervention strategy to elevate the food security status of resource-poor communities. Given that a strong relationship exists between food production and consumption, integrating aquaculture into rice production will result in a more productive and nutritionally rich farming system. The rice-fish system can also open up additional economic opportunities with multiple benefits for communal food security, including poverty alleviation and improved nutrition through aquaculture value chain services. The farming system has the potential to support the nutritional needs of vulnerable communities in a sustainable way when properly managed.

### Implementation process

Despite the challenges posed by the COVID-19 at the project's inception in 2020, the project has made significant progress and related impacts for the beneficiaries to date, such as the development of suitable integrated rice-fish production technology through participatory research actions. This included community appraisal to characterize the farming systems and on-farm adaptation experimentation to identify suitable entry points for farm diversification, followed by a series of trainings on appropriate management practices for rice-fish farming based on prevailing local conditions. This led to the creation of farmer-managed rice-fish demonstration plots which were used as educational tools to train beneficiary farmers on how to modify their rice fields to include aquaculture. Farmers gathered at the demonstration plots at intervals



Fish stocking in a rice-fish farm in Nigeria.

to discuss pertinent topics to successfully adopt rice-fish farming: topics such as field preparation or modification, water management, rice transplanting and spacing, fish stocking, pest control, fertilization measures, feeding regimes, and other field-management considerations.

### **Key expected outcomes**

- $\rightarrow$  Suitable integrated rice-fish systems developed through participatory research. The participatory needs-assessment was an essential step that led to better understanding, ownership and buy-in from all stakeholders. The diversification of rice-based systems with fish proved to be a viable strategy that provides higher returns than rice mono-cropping alone.
- → Household dietary diversity increased and/or additional income generated through enhanced production of local fish. This additional availability of fish is expected to help address the high prevalence of food insecurity in the project sites. Smoking of small-sized catfish was adopted as a value addition technique to increase the value for the farmer and increase transportability of the product.
- $\rightarrow$  Fish feed formulations were prepared using locally available ingredients, including processing wastes such as rice bran and fish offal.
- $\rightarrow$  Use of agricultural chemicals (such as pesticides and fertilizers) reduced. The lower chemical use leads to better ecosystem health and increased biodiversity.
- → Stakeholders developed capacity and participated in co-learning, notably through the exchange of experiences by farmers, extension agents and researchers to enhance knowledge, building trust and confidence in the system.
- Partnerships generated among multiple institutions  $\rightarrow$ towards advancing the farm-diversification process. The lessons learned in the first cycle of on-farm adaptation for rice-fish farming resulted into a robust and specific recommendations for rice field adaptation based on prevailing local conditions in Nigeria.

### Impact

The ultimate goal of the farm diversification is to increase productivity and access to rice and fish, improve nutritionsensitive diets, promote resource use efficiency, and generate employment and better livelihood options in the target communities. Since the project's inception in 2020, over 200 farmers with little or no knowledge of aquaculture have been trained and empowered with the knowledge of rice field adaptation to include aquaculture. At the beginning of the project, some of the farmers were initially skeptical, some curious and others surprised about the possibility of combining fish with their rice farming. However, since the demonstration there has been encouraging adoption and practice of the new system; project farmers reported increased income and expressed expectations of continuous profitability, as well as improved levels of household nutrition compared to when they were engaged in rice monocropping.



Hajia Fatima Aliyu (a project beneficiary) with her harvested fish from a rice-fish farm ready for market.

### Next steps

Following the development of the simple low-cost rice-fish technology in Southern (Ebonyi) and Northern (Kebbi) Nigeria, there is a fertile environment for consolidation and upscaling to new states and regions of the country, including technology transfer to other sub-Saharan African countries.



A rice-fish site in Nigeria.

# Black soldier fly is helping small-scale producers in Zimbabwe to increase benefits from tilapia farming



Black Soldier Fly larvae seen at Chinhoyi University of Technology, used to process organic wastes into high protein fish feed ingredients.

# **FISH4ACP** builds on momentum in support of a low-cost and protein rich innovation

The nutritious larvae of the black soldier fly are expected to reduce feed cost for small-scale producers in Zimbabwe, where the global fish value chain development programme FISH4ACP is assisting the country to strengthen tilapia aquaculture and promote opportunities for women, youth and marginalized groups without adversely impacting the environment.

Together with the Chinhoyi University of Technology (CUT), FISH4ACP is trialling black soldier fly production – and black soldier fly-based fish feed with small-and medium-scale enterprises. CUT has trained ten government extension officers, feed suppliers and farmers to pilot cost-effective black soldier fly production, harvesting and feed formulation.

"We are very excited about introducing the black soldier fly at our poultry and tilapia farm," says Rukudzo Matsaira, the Managing Director of Spring Glory farm. "We can use surplus chicken manure to grow black soldier fly larvae to feed tilapia: tilapia needs more animal protein than

Written by: Yaiza Dronkers Maarten Roest FAO Fisheries and Aquaculture Division, Rome, Italy chicken. We expect to produce enough to supply other local farmers too. This will make us more autonomous and resilient to price fluctuations in the country."

Tilapia consumption in Zimbabwe has gained in popularity but is more expensive than other fish. High costs of production are mainly due to a reliance on imported feeds and feed ingredients, which are affected by macroeconomic factors such as foreign currency exchange rates and inflation.



Professor at the Chinhoyi University of Technology, Zimbabwe, holds out a tray of insect meal made from the Black Soldier Fly larvae.

FISH4ACP, an initiative of the Organisation of African, Caribbean and Pacific States (OACPS) implemented by FAO with funding from the European Union (EU) and the German Federal Ministry for Economic Cooperation and Development (BMZ), is implementing an upgrading strategy of Zimbabwe's tilapia sector that foresees a nearly three-fold increase of farmed Nile tilapia production from 5 600 to 14 000 tonnes per year by 2032.

This increase would be driven by better access to inputs, services and markets for small-scale fish farmers, and would raise their yearly benefits from the current USD 5.6 million to USD 22 million in ten years' time.

The strategy was adopted in 2022 following a sector-wide dialogue on how to help Zimbabwe's tilapia value chain intensify. It advocates widespread use of best practices so that the sector's growth does not negatively impact local biodiversity and ecosystems. Inclusivity is another key priority: efforts to increase the participation of women, youth and marginalised groups should ensure that by 2032 they occupy 40 percent of jobs in the value chain.

# Upscaling potential for small-scale producers in Africa

Black soldier fly farming is booming. This low-cost and protein rich alternative for animal feeds could be an important innovation that helps to tackle our global dependency on soya and fishmeal. To sustainably feed a global population of 9.6 billion in 2050, there is a need for alternative protein sources for food for people and feed for animals.

Insects that convert waste material into animal feed have much potential to contribute to worldwide sustainable consumption. Black soldier flies are widely recognized for their efficiency, good nutritional potential and a strong immune system that prevents the spread of diseases. Other benefits include a low carbon footprint, being pro-poor and supporting local autonomy as they can be produced locally using local waste products at either smaller or larger scales. Research on black soldier fly has intensified in the last five years, and animal feed and organic waste conversion were found to be the two most popular topics in recent studies.

Black soldier fly farming is an emerging industry globally, with substantial investments made by industrial actors. However, the potential benefits for smaller-scale operators should not be overlooked. By strategically building local capacities there is much potential for upscaling black soldier fly farming in Africa.

### **Promising regional experience**

FISH4ACP also works on aquaculture value chains in Côte d'Ivoire and Nigeria. The initiative is still finetuning its black soldier fly activities in these countries, not only by closely following the activities in Zimbabwe but also by learning from other international development initiatives that are on a quest to tackle feed challenges. For example, in Uganda, the National Fisheries Resources Research Institute (NaFIRRI) is already taking a lead role in sustainable black soldier fly production. As part of the Global Sustainable Aquaculture Advancement Partnership, NaFIRRI will be hosting exchanges with the University of Ibadan in Nigeria. The University of Ibadan and NaFFIRI are both recognized by the African Union as Centres of Excellence in Aquaculture. FISH4ACP is coordinating with these initiatives to ensure regional synergies are developed that will pave the way for scaling up black soldier fly activities in Africa. According to Xinhua Yuan, Deputy Director of FAO Fisheries and Aquaculture Division:

"The potential economic, social and environmental benefits of insect-based fish feed are very promising. At FAO, we are connecting the different global initiatives to ensure we continue the momentum and contribute to the sustainable development of member countries' growing aquaculture sectors. In that respect, we are thrilled about the various emerging black soldier fly activities aimed at contributing to future proof fish value chains."

### Next steps in black soldier fly development

Considering the increasing global attention to insect farming, FISH4ACP is eagerly following various black soldier fly initiatives to support the sustainable development of aquaculture in Africa. The various pilots implemented by FAO this year should help FISH4ACP and other FAO initiatives answer key questions - mainly in relation to production practices, food safety concerns and the business cases to allow for larger scale support and development.

FISH4ACP will upgrade three pilot sites in the province of Manicaland, Zimbabwe, to test the production of black soldier fly-based fish feed, using different feed formulations. The success of the pilot will be evaluated based on a cost-benefit analysis, its business potential and feedback from stakeholders. Recommendations are expected later in the year and will inform the potential for upscaling in Zimbabwe.



Various feed ingredients as part of a feeding trial in Zimbabwe.

# **SEE ALSO**

Liu *et al.* 2023. The Research Hotspots and Frontiers of Black Soldier Fly during 1994–2021: A Bibliometric Analysis. Gazi Entomolojik Arastirmalar Dernegi. www.doi.org.10.51963/jers.v25i1.2340.

# **EIFAAC plans for more aquaculture activities in Europe**

The European Inland Fisheries and Aquaculture Advisory Commission (EIFAAC) held a joint meeting of its Management Committee (MC) and Technical and Scientific Committee (TSC) on 28-29 March 2023 at FAO headquarters in Rome.1 As an intergovernmental forum for collaboration and exchange of information on inland fisheries and aquaculture among all European countries, EIFAAC functions as a network linking policymakers, managers, scientists and others working on inland fisheries and aquaculture issues. The technical and scientific work of EIFAAC is undertaken through projects and working groups composed of specialists from EIFAAC member countries. The Commission provides technical advice on request, and links those who seek technical expertise to those who can provide it. With the recent accession of the Republic of Moldova and the Republic of Serbia, EIFAAC's membership has grown to 35 countries and the European Union.

discussed progress The meeting towards the implementation of the EIFAAC 2022-2024 work programme,<sup>2</sup> its upcoming activities and plans for the Thirty-second Session and related international symposium. The projects on the management/threat of Aquatic Invasive Species in Europe, as well as on Developing Advice on Sustainable Management Actions on Cormorant Populations, are showing important progress. The EIFAAC/ICES/GFCM Working Group on Eel (WGEEL) has also provided useful advice to the members in 2022. A project that will develop new fish stocking guidelines has recently started, as well as a project on the problems and challenges of climate change and its impact on inland aquatic resources, fisheries and aquaculture in Europe.

Together, EIFAAC and FAO are developing various technical aquaculture innovation and spatial planning projects for the European region. Activities scheduled for 2023 also include a workshop on methodologies for economic valuation of inland fisheries and aquaculture, and collaboration with HAKI (Hungary) in the organization of the 6th International Carp Conference.

The Government of Croatia has kindly offered to host the Thirty-second Session of EIFAAC in Pula in October 2024. An international symposium is being organized on the topic of "Building a sustainable future for inland fisheries and aquaculture in a time of multiple stressors".

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Participants of the EIFAAC Management Committee meeting in March 2023

The international symposium on "Inland Fisheries and aquaculture: advances in technology, stock assessment and citizen science in an era of climate change" was organized in conjunction with the Thirty-first Session of the European Inland Fisheries and Aquaculture Advisory Commission in Killarney, Ireland on 20–21 June 2022. The symposium was organized by Inland Fisheries Ireland and the Department of the Environment, Climate and Communications.

The symposium was attended by 105 participants from 14 countries. The main documentation was comprised of six invited papers, 35 experience papers and 15 posters. The symposium had five major themes, which were:

- 1. Inland fish stock assessment;
- 2. developments in freshwater fish monitoring technologies with an emphasis on non-destructive methods;
- 3. the problems and challenges of climate change and its impacts on inland aquatic resources and fisheries
- 4. citizen science; and
- 5. aquaculture, specifically traditional freshwater systems vs recirculation systems.

The symposium provided valuable networking opportunities for the participating scientists; especially young scientists who could share their research findings. Many promising studies and innovative technologies and methodologies were presented. This Occasional Paper in conjunction with a special issue of Fisheries Management and Ecology represents the proceedings of the symposium.

The Thirty-first Session of EIFAAC, held in Killarney from 22 to 24 June 2022, discussed and endorsed the conclusions and recommendations from the symposium.

<sup>1.</sup> Meeting documents are available at: www.fao.org/fishery/en/ meeting/41372

The EIFAAC work programme can be found in appendix F of the thirtyfirst session report, available at: www.fao.org/documents/card/en/c/ cc1986en

# FAO teaches aquaculture and agroecology at the University of Gastronomic Sciences, Pollenzo, Italy

In March 2023, FAO taught a course on the nexus of aquaculture and agroecology as part of the curriculum for students enrolled in the Master in Agroecology and Food Sovereignty programme at the University of Gastronomic Sciences of Pollenzo (USG), Italy. This oneyear interdisciplinary programme allows students to learn about the different dimensions of agriculture and food systems through experiential learning methods.

The course was offered as one of the core interdisciplinary courses of the Master's programme, with the learning goals for the students being: to understand the origin and importance of fish in food systems; the production, socioeconomic and environmental impacts of aquaculture production; and the relationship between the concepts of sustainable aquaculture production and agroecology.

This was the second time that this module was taught by FAO to international students at USG providing them with basic knowledge about aquatic food and nutrition in the context of global food production. The class in 2023 consisted of 16 students (14 female, 2 male) from nine countries (Germany, Greece, India, Israel, Italy, Norway, Slovakia, United States of America, and Venezuela (Bolivarian Republic of)). The students were keen to learn and understand the role and importance of fisheries and aquaculture within the sustainability discourse, including



Matthias Halwart provides lecture on how integrated systems can reduce competition for resources.

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Students and instructors of the Sustainable agroecosystems: fisheries and aquaculture course at the University of Gastronomic Sciences of Pollenzo, Italy.

the associated issues and challenges. The course was first undertaken in 2020 for students (10 female, 4 male) coming from ten countries.

The USG is an international university located in northern Italy. The campus is in Pollenzo, near Bra, a city in the north-west region of Piedmont. It was founded in 2004 by Carlo Petrini who is also known as the founder of Slowfood, as well as Terra Madre, and who was named FAO Special Ambassador for Zero Hunger for Europe in 2016.<sup>1</sup>

This Master's programme educates the next generation of agroecologists with the knowledge and skills to become active facilitators of change in agrifood systems and food sovereignty, including aquatic food systems. With a caseand action-based approach which integrates lectures, infographics and video representations, the students acquire knowledge on the ecological, technical, social, economic, cultural, environmental impact and risk mitigation; the policy dimensions of aquaculture production; and basic principles of sustainable aquaculture practices.



1. www.fao.org/news/story/en/item/416376

# **Overview of inland aquaculture in the Maghreb region**

In the Arab Maghreb region, the semi-arid and arid climatic characteristics do not prevent the area from having interesting potentialities for the development of inland aquaculture. Overall, the nature of inland aquaculture practiced is similar in each of these countries, albeit with inequalities in terms of the level of development.

Thus, in order to implement the recommendations of the fifth edition of the Maghreb Aquaculture Days, held in July 2019 in Ifrane, Morocco, a study on the development of the value chain of inland fisheries and aquaculture was conducted by the FAO Sub-regional Office for North Africa simultaneously in Algeria, Mauritania, Morocco and Tunisia.

The aim of the study was to:

- → draft a comparative and comprehensive overview of the status of inland aquaculture in four Maghreb countries, focusing on supply, demand, potential development and marketing;
- → propose ways of improving the development of markets for inland aquaculture products; and
- → suggest recommendations for strengthening trade between the Maghreb countries.

# The Maghreb inland aquaculture contribution remains modest with respect to the region's potential

With an annual production of about 42 000 tonnes, the combined contribution of the inland fisheries and aquaculture sectors remains limited compared to existing waterbodies and biological potential of the Maghreb region (Dickson, M. 2022). This sector could do more to contribute in the fight against poverty. It provides a source of food and income for small producers who exploit the different aquatic environments, and it can be integrated with other land-based activities such as agriculture. This combination of activities would allow optimal use of the available resources, especially water, with a circular economy approach.

Maghreb inland aquaculture faces several constraints and difficulties such as competition with the supply of marine products, scarcity of water resources and limited technical capacities of stakeholders. In addition, species raised in inland waters suffer from low popularity in domestic markets and remain unknown products in most households.

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Floating cages for Nile tilapia farming in the Al Massira reservoir (Morocco).

# The market of inland aquaculture products remains underdeveloped

In Algeria, the supply of inland aquaculture products, mainly fish and shrimps, is covered by two main sources: farms integrated with agriculture (located in the arid regions of southern Algeria) and intensive aquaculture farms. In Morocco it is possible to identify three groups of products derived from different types of aquaculture production: rainbow trout (*Oncorhynchus mykiss*), Nile tilapia (*Oreochromis niloticus*) and European eel (*Anguilla anguilla*) farming, while in Tunisia three species dominate the supply of aquaculture products: Nile tilapia, spirulina and shrimp. In Mauritania, aquaculture is still not very developed although there are a few Nile tilapia aquaculture facilities and FAO has recently supported the establishment of a hatchery for tilapia fingerling production in the inland part of the country, along the Senegal River.

Data regarding the market for inland aquaculture products is limited and often insufficient in all Maghreb countries. The study findings showed that these products have a threefold outlet: family self-consumption, domestic markets and export. In addition, it was identified that the products suffer from low awareness in domestic markets and remain unknown to a large proportion of potential consumers.

In Maghreb countries, the markets generally suffer from a transparency deficiency and poor organization. Commercial transactions often take place outside the control of the administration. When compared to whole fish, the valued added products generate higher margins.

In the four countries, the absence of effective commercial strategies to promote the consumption of freshwater aquaculture products is noted. Only a few isolated initiatives have been launched in Algeria and Tunisia.

# Aquaculture updates by region

# Climate change impacts inland aquaculture

In the Maghreb region, inland aquatic ecosystems are experiencing the full impact of climate change, whose repercussions on water resources are already apparent. The potential impacts are expected to be an increase in the frequency and severity of droughts, worsening water scarcity, and alteration of water quality and ecosystems.

The impacts of water stress will affect inland fish farming through reduced water availability for aquaculture and changes in the physical, chemical and biological characteristics of water including temperature, thermal stratification, algal blooms and oxygen depletion.

# **Recommendations for market development**

An action plan has been recommended by the study in order to develop the market for inland aquaculture products. This plan has a dual purpose and aims, on one hand, to promote and better structure the aquaculture value chains and, on the other hand, to increase awareness and improve the product image and consumer acceptability. Developing an efficient market requires the organization of marketing channels, the management of quality and traceability and securing adequate standards for product processing. An important area of work lies in promoting the image of inland aquaculture products among consumers. They should be made aware of the nutritional value of freshwater products and the benefits consuming these highly nutritious animal protein products more regularly. On the production side, intensification requires an increased supply of fry and supply of high-quality feeds and the implementation of efficient production techniques appropriate to the climatic and environmental constraints.



Tilapia farmer in Al Massira dam (Morocco).

Overall, this study confirmed the potential for freshwater fish farming in North Africa, identified a series of constraints, and proposed several areas where future activities can unlock this potential.

# **SEE ALSO**

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Naji, M., Kara, M.H., Abdel Hamid, M.L., Bouslama, N. et Crespi, V. 2023. Analyse des marchés des produits de la pêche et de l'aquaculture continentales dans les pays du Maghreb. Tunis. https://doi.org/10.4060/cc6086fr



Consecutive years of drought have reduced the water reserve of the AI Massira dam to less than twenty percent.

# Laying the groundwork for sustainable aquaculture development in Lebanon, Palestine and the Syrian Arab Republic

The aquaculture sector plays a critical role in safeguarding food security, and is a source of employment and economic growth. The General Fisheries Commission for the Mediterranean (GFCM) of the Food and Agriculture Organization of the United Nations (FAO) is supporting the implementation of sustainable aquaculture development in Lebanon, Palestine and the Syrian Arab Republic.

In recent years, the aquaculture sector in the Near East has struggled, with total production far below its potential mainly due to geopolitical circumstances, changing economic environments and the impacts of the COVID-19 pandemic. These conditions have significantly affected food production systems on which the populations depend, including the aquatic food production system.

To better understand the challenges and opportunities of the aquaculture sector in Lebanon, Palestine and the Syrian Arab Republic, the GFCM carried out three surveys, financially supported by the European Union. The surveys included an evaluation of fish farms, farmed species and production scale, as well as of aquaculture techniques, health management practices and market. These surveys were conducted in line with the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea which aims to build sustainable, equitable and inclusive fisheries and aquaculture sectors (FAO, 2021).

The outcomes of the surveys have provided valuable insights into the sector, which will allow the GFCM to provide technical guidance to increase resilience and sustainability, particularly for small-scale farmers.

# Lebanon

Aquaculture is essential for food security and economic growth in Lebanon. The main species produced in the country are trout (*Oncorhynchus mykiss* and *Salmo trutta fario*), common carp (*Cyprinus carpio*), Nile tilapia (*Oreochromis niloticus*) and marine species such as whiteleg shrimp (Penaeus vannamei). However, the country's aquaculture sector is in need of improvement: many farms are unregistered; veterinary services for fish health management are limited; regulated monitoring is absent in almost 80 percent of the farms; and gender

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Aquaculture farms in Hermel, Lebanon



Feeding operations in Hermel, Lebanon



Trout aquaculture pond in Beqaa, Lebanon

imbalance persists in the sector, with men dominating ownership, investment and management roles.

Furthermore, the potential of marine aquaculture remains untapped and freshwater production systems are operating at suboptimal levels. As such, the carrying capacities of marine and freshwater bodies need to be studied and hatcheries should be developed to meet demand. Specialized vocational training in aquaculture is highly recommended to strengthen farmers' practical skills and improve their effectiveness in fish farming and securing the quality of the final products.

The GFCM is contributing to capacity-building through the provision of training on mapping tools for administrative staff and farmers in order to improve their skills in spatial planning.

# Palestine

Aquaculture has not yet found a solid base in Palestine. Since its inception in 1995, the sector has faced numerous challenges, including a lack of expertise in both the public and private sectors. The survey campaign revealed that total aquaculture production in 2020 amounted to approximately 700 tonnes. While production has increased more than fivefold since 2011, the limited number of hatcheries is a blocking issue. Additional facilities should be constructed to meet fingerling and fish feed demand.

As there is a lack of specialized personnel, the assessment recommended to train veterinarians, biologists and farm personnel in sanitary management. It also advised to improve the gender balance of the sector which is uneven, with women making up only 12 percent of the total workforce.



Irrigation tank used in Aquaculture in West Bank (top), seabream aquaculture tanks using solar energy in Gaza (bottom)

# **Syrian Arab Republic**

The aquaculture sector in the Syrian Arab Republic is unique: in difficult times, small-scale farming supports livelihoods and provides employment for displaced families. However, the sector is facing many difficulties including increasing costs of production.

The survey revealed that in 2022 there were 671 aquaculture farms in the Syrian Arab Republic, together producing around 7 800 tonnes of freshwater species such as the common carp (*Cyprinus carpio*), blue and Nile tilapia (*Oreochromis* spp.), rainbow trout (*Oncorhynchus mykiss*). Additionally, African sharptooth catfish (*Clarias gariepinus*), grass carp (*Ctenopharyngodon idella*) and silver carp (*Hypophthalmichthys molitrix*) are produced as

secondary species in semi-intensive polyculture farming systems to reduce production costs.

Thanks to affordable prices, market demand for these species is increasing. Meanwhile, stakeholders are working on the development of marine aquaculture, which has the potential to generate additional income and employment opportunities. Although hatcheries in the country already provide nearly three million fingerlings annually, it is also necessary to develop additional hatcheries and feed production facilities to support growth in the sector.

The majority of farm owners, who are also the main farm workers, are aged between 30 and 40 and have limited aquaculture skills. Men make up over 95 percent of the workforce, with women primarily performing basic tasks in exclusively family-owned facilities. Action is needed in this regard to provide training sessions, promote gender balance, and enhance research and investment in the sector. As the sector is also experiencing a lack of veterinary services, it is important to install regular health supervision bodies to ensure better fish wellbeing.

# Conclusion

Based on the results of the surveys, the GFCM was able to assist in identifying the main issues and defining priorities for future work with the aims to support the sustainable development of the aquaculture sector. In particular, creating the enabling conditions for enhanced aquaculture development in rural communities through farmers working in close collaboration with governments and stakeholders can help improve production systems from technical, market and management perspectives. More specifically, the surveys identified research priorities on selective breeding and hatchery management, as well as the need for training for farmers, veterinary support and species diversification.

The surveys also highlighted the importance of improving gender equality, youth employment, and participation in economic opportunities and decision-making processes. Finally, the surveys stressed that it is critical to encourage investors and farmers to work closely together to promote the sustainable development of the aquaculture sector.



Water quality control at aquaculture facilities, Syrian Arab Republic

# **SEE ALSO**

**FAO.** 2021. GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea. Rome, FAO. Also available at: www.doi.org/10.4060/cb7562en

# High-Level Meeting maps ways to promote investment, public and private support to aquaculture transformation in the Asia and the Pacific Region



Participants to the meeting.

The FAO Regional Office for Asia and the Pacific (FAORAP), in collaboration with the Network of Aquaculture Centres in Asia-Pacific (NACA), organized a High-Level Meeting on "Aquaculture Transformation in Asia and the Pacific Region" on 22–23 November 2022. This virtual event served as a forum for governments, private sector, and development partners to identify policy,

# Written by:

Tipparat Pongthanapanich FAO Regional Office for Asia and the Pacific, Bangkok, Thailand innovation and investment priorities for aquaculture transformation in the region by 2030. The meeting gave special attention to the opportunities for enhancing regional cooperation and partnerships to progress aquaculture transformation at the scale needed.

With over 60 participants from more than 20 countries, the meeting included country and business showcases. Panelists from governments, pre-competitive platforms and development banks provided diverse perspectives on strategies and mechanisms for stimulating innovations and investment and enhancing collaboration. The specific objectives of the High-Level Meeting were to: The aim of the study was to:

- → Engage senior policy makers and business leaders in the process of defining regional targets, action areas and initiatives for aquaculture transformation in the region by 2030;
- → Identify strategies and mechanisms to stimulate innovation and investment, as well as enhance collaboration in the defined action areas;
- → Recommend follow up actions and commit to prioritizing aquaculture transformation in the region as a main contributor to global development targets;and
- → Give special attention to the opportunities for enhancing regional cooperation and partnerships to progress aquaculture transformation at the scale needed.

A highlight of the High-Level Meeting was the presentation of the draft White Paper on "Aquaculture transformation -Innovation and investment for sustainable intensification and expansion of aquaculture in Asia and the Pacific region." (FAO & NACA, 2023) In collaboration with FAORAP, NACA developed the document to propose strategic roadmaps for aquaculture transformation in Asia and the Pacific region by 2030. It provides a vision for 2030 in which aquaculture in Asia and the Pacific region is transformed towards more efficient, inclusive, resilient and sustainable aquatic food systems through innovation, investment and partnerships. The White Paper is broadly aligned with the strategic goals of FAO's Blue Transformation Roadmap and provides guidance on how to translate it into actions to support sustainable intensification and expansion of aquaculture, relevant to the context of Asia and the Pacific region. The objectives and expected outcomes from aquaculture transformation are provided in the White Paper, together with a series of targets and action areas under each target.

Key messages and recommendations of the High-Level Meeting included:

- → Governments and industry were already taking action to make aquaculture more sustainable with examples provided from Australia, China, India and Thailand. The sharing of knowledge and practical experiences will help accelerate aquaculture transformation in the region.
- → Innovation and entrepreneurship must be encouraged, along with promoting socioeconomic and climate resilience, de-risking research and development investment, and ensuring equitable benefit sharing.
- → Data from the different aquaculture stakeholders in the region has the power to inform inclusive investment. There are important complementary roles of both governments and the private sector.
- → There are considerable benefits from purposeful aquaculture company collaboration, and precompetitive collaboration has advantages in terms of speed and scaling of solutions thus stimulating industry ambition for change, improving technology transfer, and driving efficiencies in aquaculture and investment.
- → Financing for sustainable aquaculture is becoming available, but governments need to create adequate policies to lower investment risk, such as through



aquaculture zoning and supportive policies. Business enterprises need to come up with investable businesses that respond to these challenges.

- → Aquaculture micro-, small- and medium-sized enterprises (MSMEs) need particular attention, including both farming and value chains. MSMEs are the largest group of aquaculture businesses in the Asia-Pacific region. The uptake of more sustainable practices in an inclusive way among this group promises substantial social, economic and environmental outcomes.
- → Regional cooperation should be enhanced around White Paper Action Areas.
- → Financial resources must be mobilized to progress aquaculture transformation. Funding mechanisms should be established to take risks in research and development, stimulate innovation and entrepreneurship, and build the pipeline of investments in sustainable aquaculture enterprises to transform them in an inclusive way.

The White Paper includes a roadmap to support implementation and monitoring by key actors, featuring four key pathways:

- 1. the development of national aquaculture transformation innovation and investment plans;
- 2. the need for greater regional and international cooperation;
- 3. the need for more innovation and investment; and
- 4. monitoring progress and shared learning.

These actions, along with the overall recommendations of the 2022 High-Level Meeting will be followed up in 2023.

# **SEE ALSO**

**FAO & NACA.** 2023. Aquaculture transformation – Innovation and investment for sustainable intensification and expansion of aquaculture in Asia and the Pacific region. Bangkok, FAO. Also available at: www.doi.org/10.4060/cc4962en

# Overview of current status, challenges and future trends on seaweed farming in the Pacific region



Seaweed farming in Tonga using a floating raft of bamboo.

# Introduction

The Pacific Island Countries and Territories (PICTs) have actively collected wild seaweed and cultivated various species of seaweed over the past decades. Several local and exotic seaweed species have been both cultivated and harvested from the coastlines of the Pacific islands traditionally for food consumption and as a natural fertilizer. Many communities in these regions rely on this production for a significant portion of their income.

However, production is relatively fragmented across the Pacific Region. The economic benefits of seaweed farming are high given the relatively low GDPs of many PICTs. Furthermore, the involvement of women and youth in the sector is relevant for its livelihood generating potential.

# Targeted aquatic commodities including native and exotic species

The production of seaweeds is largely based on the cultivation of species of the genus *Kappaphycus*, intended for export as raw materials to produce important hydrocolloids such as agar, alginates and carrageenan. These species are not native to the Pacific Region and were introduced in different waves of introduction of exotic genetic material in the 1950s and 1960s. Countries like the Solomon Islands have maintained a relatively constant production of these species, mostly destined for export.

In addition, other countries, mainly located in Polynesia, have focused their production on local species of the genus *Caulerpa* (among others) for both domestic and

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Jamie Whitford Pacific Community (SPC) Noumea, New Caledonia export markets – destined mainly for Asian markets, but for direct human consumption.

Furthermore, in several Polynesian countries including Tonga, the production of "mozuku" seaweed (*Cladosiphon* spp.) either for domestic consumption or for exports is gaining a lot of attention from national governments, investors, farmers and exporters.

# Challenges and bottlenecks for sustainability and expansion

The production of seaweeds in PICTs presents numerous limitations for its sustainable maintenance and responsible expansion, such as the optimization of production systems, management of disease and epiphyte risks, improvement of harvesting and post-harvesting strategies, storage, preprocessing and processing strategies, as well as facilitation of negotiations for export, among others. Moreover, quality assurance, consistency and maintenance are key challenges faced by many producers and exporters.

Meanwhile, challenges associated with climate change are notably affecting the consistent production and high quality of seaweed crops in the Pacific. These challenges include rising temperatures, increased eutrophication, drastic changes in salinity and pH – mostly associated with extreme weather events, increased prevalence and incidence of infectious diseases (for example iceice disease syndrome) and pests such as epiphytes, as well as existing conflicts with other users of the same coastal resources. These challenges that main challenges to seaweed production in PICTs are to maintain a constant and adequate production volume considering its geographical isolation and to ensure optimal and constant quality throughout the production system and storage.

Development of the culture of native edible seaweed species traditionally consumed in the region with an

important cultural value, including *Caulerpa* spp. and Mozuku, is required to improve domestic food supplies, assure food safety requirements, and access regional markets with value-added products. Furthermore, national legislation related to seaweed farming, processing, marketing and consumption is relatively vague and needs further development and alignment.

At the same time, developed countries within the region including Australia and New Zealand have experienced a recent rise in imports of edible and pharmaceutical seaweed products, which could drive domestic culture.

Even though seaweed-farming production has declined over the last five years in most PICTs, this commodity continues to play an important role at the economic and rural development level in various countries and territories within the region. For example, in Solomon Islands, seaweed farming is one of the main sources of income on Wagina and Manaoba Islands and is often run as a family business, with more than 80 percent of women in these two islands involved either directly or indirectly in seaweed farming (Jamie Whitford, personal communication). Through the expansion of the traditional applications of locally grown seaweed, there are also opportunities for the Solomon Island farmers to sell the products to neighbouring communities as well as in the capital, Honiara.

Regarding seaweed consumption, Samoan consumers have reported consumption of sea grapes especially linked to traditional events or ceremonies, noting it as a choice food chosen for taste and value for money, and recognizing its nutritional value.

The cultivation of seaweeds currently plays an important positive role on Pacific communities and may continue to do so in the future by facilitating food security, improving quality of life, enhancing livelihoods, and diversifying income generation activities. However, coherent and rapid action is required to minimize production risks and find feasible solutions to the main constraints faced in the production and marketing of seaweed.

### Pacific seaweed production data

In contrast to global trends, seaweed production in PICTs has declined since 2000. *Kappaphycus alvarezii* production has suffered from technical issues that relate to productivity declines mostly due to rising water temperatures and poor farm-management practices. Moreover, the variation in production and quality of final products creates uncertainty in the market chain. Precise action points have been identified by many governments, such as the provision of a regional standard protocol for seaweed production to deliver a consistent supply and grade for carrageenan processing, which will build confidence in the marketability of the product.

Furthermore, alternative product streams for low to medium quality *Kappaphycus*, such as solid or liquid agriculture fertilizers or biochar, may provide an opportunity to maintain commercial activities where acceptable quality grades cannot be consistently met (consistent high-quality production is required for hydrocolloid extraction, for example).

Edible seaweed production of local species including *Caulerpa* and Mozuku is very encouraging in some PICTs, for example Fiji, French Polynesia, Samoa and Tonga. However, this requires the development of appropriate farming, processing and value adding strategies and techniques to prolong shelf life and improve access to both domestic, regional and international markets.

Looking at the production in major producer countries, Kiribati produced *Kappaphycus* from only one atoll (Fanning Atoll) in the early 2000s. Production faced domestic supply chain problems related to limited infrastructure used to transport the seaweed from Fanning to the main island of Tarawa, as well as key environmental challenges including heavy storms, increased water sediments and eutrophication, rising water temperature, and ocean acidification. Furthermore, Kiribati seaweed farming is competing against copra production, which has a regulated price, mostly in terms of labour and public sector subsidies and assistance.

Fiji's seaweed has been heavily affected by cyclones in the past years. Although Fiji had three local companies buying dried *Kappaphycus* in the early 2000s, now only a single trader is left.

Solomon Islands' number of Kappaphycus seaweed farms have been slightly decreasing in the past years, mostly due to Solomon Island's limited local buying agents and domestic supply chain problems. Having said that, Solomon's production volumes seem stable, with an annual average of 12 000 metric tonnes of wet weight production.

The Australian and New Zealand seaweed industries are currently small, with most of the production coming from various endemic species of kelp, collected as beach cast. This production is predominantly for export to large alginate-manufacturing companies and for use as biofertilizer products. There are no commercial seaweed farms in Australia or New Zealand, though there are some pilot projects for the cultivation of *Ulva* spp. and invasive *Undaria* spp. There are research projects underway to progress the production of *Asparagopsis*, a genus endemic to both Australia and New Zealand, which shows promise in reducing enteric methane emissions when used in feed for cows and other ruminants.



Caulerpa harvested from a farm in Samoa.

Aquaculture updates by region

Emerging market options in Australia and New Zealand appear promising. There has been a long-standing production of beta-carotene from microalgae grown in large tidal ponds previously used for salt production. Also, Atlantic salmon companies in both countries are trialling the development of multitrophic aquaculture systems to reduce the impact of nitrogen and phosphorous produced by marine fin fish farming using mussels and propagated kelp adjacent to sea cages. Land-based farming of *Ulva* spp. is in a commercial pilot stage aiming at being added to feed manufacturing, as well as reducing the nutrient outfall of landbased fin fish farming (barramundi, abalone and shrimp). Land-based farming of Ulva spp. is also being tested for use as a carbon sink and use as fertilizer.



# Local seaweed species for human food consumption

Wild harvesting of *Caulerpa* is limited in most Pacific countries due to fishing pressure and environmental challenges, and this has motivated many countries to look into *Caulerpa* farming. Several *Caulerpa* species have been traditionally consumed in the region and have an important cultural and nutritional value as healthy fresh products, easily available for rural and isolated communities. Furthermore, there is increasing interest from exporters, destined for developed Asian countries including China, Japan and the Republic of Korea. Low-technology culture methods have been introduced, including off-bottom culture in plastic trays. Development of preparations and packaging options for transport to reduce spoilage and to access regional markets have also been tested and validated.

Mozuku (*Cladosiphon okamuranus*) is a highly valuable species that is very rare in many regions of the world, is endemic in Tonga and Samoa and possibly the wider Pacific, and consumed traditionally as fresh food. Nowadays, a private-sector modern processing facility (South Pacific Mozuku Tonga) is producing dried mozuku, for both domestic and export markets, such as Japan and United States of America.

# **Regional challenges**

Major regional challenges faced for the sustainable expansion and intensification of the seaweed farming sector in the Pacific Region are listed below:

- → Competition against established industries in Indonesia, Malaysia, Philippines and Thailand
- → Logistical challenges and small populations, difficulty in identifying traders
- → Price fluctuations, and high bargaining power by the traders
- → Limited interest in seaweed farming when compared to nationally subsidized copra farming or more lucrative sea cucumber fisheries

- → Good aquaculture practices not yet established for species currently being harvested
- → Limited processing and/or value addition undertaken by the farmers or local community, reducing the farmers' share of the total value and limiting access to foreign markets
- → Regulatory frameworks, including policies and laws governing seaweed farming in the Pacific Region are limited or non-existent and need to be developed and enforced
- → Limited management and monitoring actions against biosecurity risks including diseases, pests, epiphytes, and invasive species

# The way forward

Wild harvesting of Caulerpa is limited in most PICTs. Major actions identified by seaweed stakeholders within the region for future development of the sector include actions to empower the farmers and strengthen the value chain, both upstream and down. This may include facilitating connections with existing and new hydrocolloid buyers and improving the negotiating power of the farmers. It may also include identifying and developing new seaweed products for traditional and emerging markets. Farmer clusters can be used to achieve productive scales and stronger supply and marketing solutions. Improved seed supply through and nursery production, complemented with genetic selection will enhance production and quality of the final product. Moreover, improved varieties can be selected for traits to offer better adaptation and resilience to climate change challenges. Production can be further improved through modernization and digitalization of farming systems and environmental monitoring. Finally, strengthening of existing domestic markets, including through awareness raising, can further the contribution of seaweed to diverse and healthy diets in coastal communities.



# Increasingly important and progressively inclusive? Reflections on the evolving role of aquaculture in the Blue Economy

T hough frequently applied as an umbrella term referring to activities, ambitions, or development targets in the coastal/ocean space and utilization of resources therein, the**Blue Economy**remains without a broadly agreed definition of its sectoral or spatial scope. While aquatic food production, particularly marine fisheries, generally feature prominently in Blue Economy frameworks and strategies, the role of aquaculture is more unclear.

This article provides an update on the origins and trends of Blue Economy discourse, with particular emphasis on the role of aquaculture production both in marine and freshwater, exploring possible policy and programming considerations and implications for aquaculture stakeholders.

Some countries, institutions and stakeholders have expressed concern over the use of the term "Blue Economy" in international and regional fora, and FAO does not use it in its normative or programmatic processes, preferring instead the terms "blue transformation" (when referring to aquatic food systems) and "sustainable ocean economies" (when referring to processes beyond aquatic food.)

# Origins of the Blue Economy and its opacities

Blue Economy emerged as a policy trend over the decade 2010–2020. Drawing inspiration from nature, the early concept was used to illustrate economic systems built in harmony with nature rather than carrying a specific policy or narrative (Pauli, 2010). The perception of the Blue Economy as a blue variety of the Green economy featured prominently in the international development context, linking it to the broader sustainable development

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movement, often considered to originate with the Brundtland Report (World Commission on Environment and Development, 1987).

Inspiration is also drawn from the Rio+20 Conference on Sustainable Development, calling for the systematic re-organization of the world economy to achieve environmental, economic and social stability, which includes decent jobs, sustainable livelihoods and rights for all people. (UNGA Resolution A/RES/66/288, 2012). The intrinsic link between the Green and Blue Economies has since been promoted by the UN and other international organizations (UNEP, FAO, IMO, UNDP, IUCN, WorldFish Center, GRID-Arendal, 2012). For Small Island Developing States (SIDS) the development of sustainable blue economies offers a policy tool to combine objectives of sustainable economic growth with the preservation of natural capital.

Thematically, Blue Economy may include a wide range of sectors and activities, including traditional sectors such as marine fisheries and aquaculture, tourism, offshore oil and gas, and maritime transport, but also new and emerging activities such as offshore renewable energy production, desalinisation, seabed mining, marine biotechnology and bioprospecting. However, inconsistent thematic and spatial interpretations distinguish fundamental differences in Blue Economy approaches. This often results in ambiguity of the characterization of the same activities depending on whether they occur in the inland or freshwater domain, with aquaculture production being a prime example of this.

At first, Blue Economy did not relate specifically to oceans or inland waters (Ababouch, 2015) but has increasingly become more closely connected to the oceans and coasts. The term has been closely associated with ocean economy, a concept used to describe a re-organization towards traditional and emerging ocean-oriented economies (UNEP, 2012). The introduction of Sustainable Development Goal (SDG) 14 "Life Below Water" has aligned both academic approaches and stakeholder

Spatially restrictive, typically Thematically broad, potentially interpreted as ocean economy covering both extractive and equivalent, based on the use non-extractive activities and of marine and coastal space the use of living and non-living and resources. resources. Intrinsically linked to the green Spatially broad, encompassing the use of ocean, coastal, and economy and sustainability freshwater (such as lakes, agenda, excluding sectors rivers, and inland waterways) such as offshore oil and gas space and resources. and seabed minerals. Prevailing interpretations of the Blue Economy.

priorities to associate SDG 14 with the development of a sustainable Blue Economy. (Lee, Noh and Khim, 2020). This perceived interdependency has arguably powered an ocean-centred Blue Economy paradigm.

Conflicting perceptions of sustainability represent an important division in Blue Economy conversations. Noteworthy concerns exist particularly regarding activities connected to the extraction of non-living resources. For example, international financial institutions (IFIs) such as the World Bank and the Asian Development Bank do not include extraction of offshore oil and gas and seabed minerals when providing Blue Economy financing (Asian Development Bank, 2022; World Bank, 2021). Critics fear that unsustainable demand and practices in the aquatic space and its resources hamper the food production capacity of aquatic environments. Fundamental scepticism persists regarding the commodification of aquatic food, suggesting that it rather should be regarded as a domestic public health asset considering its nutritional value (Vianna, Zeller and Pauly, 2020).

# The growing role of aquaculture in the Blue Economy

Aquatic food systems, both oceanic and inland, have continued to grow in size and value and represent core sectors within the Blue Economy, with aquatic foods from oceans, rivers, and lakes being documented as vital to provisioning high-quality animal protein, polyunsaturated fatty acids and micronutrients (FAO, 2022a), whose key role for food security is recognized in global forums such as the UN Food Systems Summit 2021 (UNFSS, 2021). As such, fish farming– both marine and freshwater aquaculture – was early identified as a potentially important driver of the Blue Economy (Boto, Phillips and D'Andrea, 2013).

Aquaculture production constitutes the main driver of the increases in aquatic food production (FAO, 2022c). In 2019, an estimated 61 million people were engaged in the primary sector of fisheries and aquaculture. About 22.3 million people were employed in aquaculture and 38.6 million in fisheries (FAO, 2022a). Over 90 percent of the livelihoods that are directly dependent on fisheries and aquaculture occur in developing countries, mostly in small-scale operations (Ababouch, 2015). Smallscale investments, for example in pond aquaculture, can promote both local economic development and enhance food and nutrition security by providing affordable and healthy protein.

Lately, marine aquaculture has already overtaken fisheries in terms of direct human consumption, and while it is

unevenly conducted in different regions and countries, aquaculture production is expected to continue increasing faster than capture fisheries overall (FAO, 2022a). However, the dominance of the ocean and coastal-centred approach directly or implicitly excludes freshwater fish farming and inland fisheries; ocean-centred strategies may omit freshwater aquatic food production.

# Freshwater aquaculture, an overlooked Blue Economy sector?

Inland aquaculture production from freshwater sources, such as rivers and lakes, and fish farms, supersedes marine production (FAO, 2022c). While aquaculture growth potential exists in both freshwater and marine environments, whether or not freshwater production is included in the Blue Economy therefore plays a key role when assessing the scope of aquatic food within the Blue Economy.

Advances in science and technology progressively enable the establishment of new activities that challenge the traditional differences between marine and freshwater. For example, Blue Bioeconomy developments allow novel products and value chains based on both marine and freshwater resources. Technological advances in aquaculture through investments in land-based Recirculating Aquaculture Systems (RAS) are less dependent on local climatic conditions and represent a growth opportunity independent of climatic conditions (FAO, 2022a).

Private-sector investments hold important roles in scalingup aquaculture production. In recent years, several international investment funds have emerged which are specifically aimed at tapping into the perceived growth potential of aquaculture in the Blue Economy. Several express an ambition to align their objectives with marine/ ocean-centred Blue Economy approaches, consequently emphasising marine aquaculture. In order to target impact investors and attract sustainable finance, contributions to healthy oceans and SDG 14 are often emphasised.

Broader, more inclusive approaches to the Blue Economy exist: The African Union's (AU) Blue Economy strategy encompasses resources both in the oceans and inland waters (AU-IBAR, 2019). Similarly, the Intergovernmental Authority on Development (IGAD) uses Blue Economy as a reference to the sustainable economic exploitation of the resources of the oceans, lakes, rivers and other water



bodies (IGAD, 2022). Ethiopia, a landlocked country, recently launched its National Blue Economy Strategy in 2022, wherein the aquaculture potential is highlighted (The Federal Democratic Republic of Ethiopia, 2022).

Noteworthy changes may be underway in the perception of the role of aquaculture in the Blue Economy. A prominent example is the European Union, where the Blue Economy often has been seen as marine-based and linked to sustainable development of oceans and coastal resources (European Commission. Directorate-General for Maritime Affairs and Fisheries, 2022). Recently, a broader definition can be observed in which the Blue Economy "encompasses all industries and sectors related to the EU's seas, inland waters, and coastlines" (European Commission, Directorate-General for Maritime Affairs and Fisheries, 2023). Important funding mechanisms such as the European Maritime, Fisheries and Aquaculture Fund (EMFAF) already provide funding for aquatic food production both in the marine and inland domains.

# Future considerations for aquaculture in a Blue Economy context

Adoption of Blue Economy agendas or commencement of such processes by an increasing number of states, regional organizations, international financial institutions, private sector actors, as well as UN agencies suggest that Blue Economy should maintain a significant role in international development discussions.

Providing a powerful tool for agenda setting, the Blue Economy offers a framework for intersectoral and interdisciplinary dialogue, collaboration and a more holistic policymaking and programming approach. Despite opacities in its definition, the concept offers an umbrella to attract and channel funding and investments. Considering the untapped potential in its perceived future, it is likely that both public and private actors will consider both existing and emerging Blue Economy sectors such as aquaculture as increasingly fundamental to meet both financial objectives and the future demand for healthy, nutritious and sustainable food.

Realising these ambitions will require an integrated approach to aquatic foods that must link land and water and connect multiple actors. As attention to Blue Economy is growing, so will the demand for aquatic and adjacent space, meaning that aquatic food production will be competing with other sectors for consideration and funding, representing a possible bottleneck to unlocking the expected growth of aquaculture production.

FAO holds an important role in supporting the development and advancement of sustainable aquatic food systems production and its support to Members under any development frameworks. Guided by its Blue Transformation Roadmap (FAO, 2022b), its holistic approach to fisheries and aquaculture production with a complete value chain approach also provides an umbrella to integrate marine and freshwater aquatic food systems.

Aquatic food should therefore form a core focus of Blue Economy investments and practices (FAO, 2022a). In this

context, the growing acceptance of including freshwater aquaculture in Blue Economy agendas and frameworks may have implications for the perception and possibilities for aquatic food and aquaculture production amid the ongoing Blue Economy discussion.

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# Interview with Yuki Chidui, sushi chef and salmon farmer – challenging gender norms throughout the value chain

# The world of sushi restaurants

s one of the final links of the aquaculture value chain, restaurants are a final stage for a product before it reaches the final consumer. When considering restaurants from a gender perspective, men are more likely to hold leadership positions, receive higher salaries and have greater access to opportunities for career advancement. Men particularly are most likely to be found as chefs and head cooks in kitchens. As is the case throughout the aquaculture value chain, the restaurant industry including sushi restaurants - has traditionally been maledominated. In Japan, the sushi restaurant remains a firmly masculine operation that follows strict gender roles and it is only recently that some women have been breaking new ground as sushi chefs. FAO's Gender Team of the Fisheries and Aquaculture Division had the opportunity to interview one of these women, Yuki Chidui, who has also recently started her own salmon farming business in Tokyo.

# Yuki, how did you end up being a sushi chef?

From an early age, I had a dream of pursuing a creative career as an artist. In college, I majored in fine arts, which further deepened my passion. However, I still had a vague idea that I wanted to enhance my work as a creative director, regardless of the boundaries of the genre.

Starting when I was an art college entrance exam student in my late teens, I worked part-time for six years at a longestablished sushi restaurant with its main branch in Ginza, Tokyo.

One day, I came across a job advertisement for Nadeshiko Sushi, where women were making a new style of sushi outside the usual masculine norms. When I saw this advert, I was inspired to create a new kind of sushi that had never been made before, and I decided that I wanted to become a sushi chef, not just a part-time worker in the restaurant. As a pioneer in creating sushi restaurants as a woman, I still want to create a sushi restaurant that resonates with art, using my personality and creativity.

Written by: Jennifer Gee **Roxane Misk** FAO Fisheries and Aquaculture Division, Rome, Italy



A selection of speciality seasonal sushi created by Yuki.

It is rare to find women who are sushi chefs - can you explain what gender norms are in Japanese culture and how are they linked to this profession?

In Japan, it has traditionally been assumed that "sushi chefs are men", and it is still difficult to break the rule once it has been established. The reason for this was forcibly attributed to gender differences, such as the difference in the temperature of male and female hands and female menstruation.

However, I believe that these traditions and reasons were created by men for men in the first place in the sushi society. Women can make sushi just as good as men. I am willing to overcome this irrationality and, if necessary, overcome tradition to expand sushi to the world, regardless of gender.

### Was it hard to break into a traditionally male field?

Yes, it was not easy. If the workplace is "women-only" or if no men are involved in the operation, then it is less difficult. However, if there is a male sushi chef there, it is difficult to overcome that barrier because that man will have power through the use of tradition. Also, when a female sushi chef expresses her "denunciation of sexist

society" on social networking sites or in the mass media, suddenly there is a backlash on social media. I think this is because these men are afraid that they will be deprived of their place in the world.

Do you still face challenges based on this?

Over the past decade or so the barriers to women's entry into the sushi industry have been gradually broken down through the efforts of myself and several other female sushi chefs. However, it is still men who hold the real power of leadership, decision-making, and management in the sushi society. In many cases, women are merely assistants to the men, or decorative CEOs to complement the men. In order to change this, I have become a manager myself, nurturing women and actively taking action.

You opened your academy for training sushi chefs. Can you explain the philosophy behind it?

I believe that the program has been able to convey basic techniques and ideas to those who are trying to create new sushi that is not bound by conventional values and traditions, especially to those who are aspiring to become female sushi chefs.

What motivated you to open it? Is it exclusively for women or does it also include men?

Because I want to make sushi chef a profitable job for women, a profession that women aspire to, and a career choice to help women become independent. To achieve this goal, I understood I had to start an academy to give detailed guidance and teach the philosophy behind the work as that was not fully possible through giving the job training while I was focused full time on restaurant management.

I initially planned to start this program only for women. Now, however, I believe that many people including young men should also be provided with this education for their future sushi career. Many people are supporting my idea now.

We met most recently at the Eighth Global Conference on Gender in Aquaculture & Fisheries, where you presented your work and some of the challenges you face. What motivates you to participate in Global Events on Gender Equality and Women's Empowerment in the aquaculture and fisheries sectors?

I have started not only a sushi restaurant but also an aquaculture business because I wanted to achieve my goal not only in Japan but in the whole world. So, I was finding gender issues in the entire aquaculture industry and I wanted to participate. I also wanted to learn about the latest trends in aquaculture and gender in the world.

More recently you have started a new venture – salmon farming! Can you tell us a bit more about what inspired you to take an active role in this part of the aquaculture value chain?

Nigiri-sushi, which originated as an everyday food in the Edo period approximately 400 years ago, has now become a special gastronomic delicacy. Looking beyond making sushi, I am committed to the health and safety of our customers and to creating a delicious future for fish. I wanted to produce tasty and healthy fish myself, using safe and healthy feed, and to deliver that to my customers.

What is the particular focus of your salmon farming operation?

Now I am focusing my efforts on raising healthy salmon.

The salmon I produce is sold under the brand name "Yakuzen Salmon" and my salmon was the first in the industry to obtain a Food with Functional Labeling<sup>2</sup> in the salmon aquaculture industry in Japan. There are only seven cases in Japan for fish with this certification. Moreover, it is very rare for a small company like mine, with a female sushi chef, to obtain this certification!

I think this is very good news in the seafood industry to improve the healthiness and safety of fish products. Therefore, I decided to share it with FAO and with the world!

# Where is your salmon farm? Do you have any plans to expand? How many employees do you have on the farms and what is the gender balance like?

Currently, Hokkaido is the main site of my salmon farming. Hokkaido's rich natural environment makes it the most suitable place for salmon farming in Japan. Currently I only have one production site, but I am in talks to expand to other farms to produce "Yakuzen Salmon". Most of the fish farms are operated by men. However, in family-owned fish farms, I found that women are doing the major roles such as feeding the fish.

# What type of feed do you use? Have you focused on a special formulation?

I am a certified Yakuzen Instructor.<sup>2</sup> I have used this knowledge to provide special nutrition to salmon by raising them on an autogenous formula that I developed myself. I have named this feed "Yakuzen Feed" and it is also safe for direct human consumption. The nutritional value of this feed is higher than that for regular salmon. The salmon that is produced using this feed is free of odour, has a moderate fat content, and has a delicate taste.

# Can you explain your strategy for marketing?

First, I am able to provide consumers with safe, secure and delicious products through the Yakuzen branded fish. It is certified as a functional food approved by the Japanese government. Furthermore, such healthy fish invented by a female sushi chef is unprecedented.

Salmon is popular among young people, but not among many middle-aged men who do not have a history of eating raw salmon. Finally, I have applied my training in fine arts

This government-certified label is generally used for foods that claim positive biological effects beyond ordinary nutritional effects based on scientific validation. www.mhlw.go.jp/english/topics/foodsafety/ fhc/02.html

Yakuzen translates from Japanese to mean a method of cooking using medicinal ingredients so that the ingredients are rendered to be delicious while still maintaining their medicinal qualities. This also implies using only seasonal foodstuffs of natural origin.



Yuki at her salmon farm on Hokkaido Island, Japan.

to design packaging for the salmon that is as gorgeous and beautiful as my sushi.

Have you encountered any surprises (good or bad) in your journey to being a salmon farmer? Of course!

The first good thing was that through actually raising fish in a fish farm, I have studied that the taste and quality of fish is greatly influenced by the feed. And, although I had not been involved in the fisheries industry before, seeing live fish and the fish farm I think I was able to propose new product ideas that were not bound by the stereotypes of the past.

# Are there any new obstacles, or are they the same hurdles you faced before?

Yes, there have been many. Negotiations and business meetings with a single woman are inevitably still looked at with peculiar eyes. And in order to solve this problem, I need to acquire more fishery knowledge to be taken seriously. Through such efforts, I will be able to tell many people around the world about this initiative, so that they will eat my salmon all over the world!

While working as a sushi chef you have discussed before that there are many problematic stereotypes about women working in the field in the field of salmon farming – have you encountered similar stigmas? As far as I understand, many women are not interested in the fishing industry, much less aquaculture. Sushi can still be performed in front of customers and be in the limelight, and this can make it a more appealing career. However, aquaculture is hard work, much of it out of the limelight, and this can make it a less appealing career path particularly when paired with other traditional constraints. I would like to change this system in the first place. What do you see as your next steps with your salmon farming business?

I would like to enhance the value of Japanese domestic salmon with this Yakuzen Salmon. As a Japanese brand salmon, I would like to make it the most popular salmon in the world by incorporating the good points of Japanese cuisine. We would like to spread the healthy and delicate taste of Japanese Yakuzen Salmon to the world, just like Japanese cuisine.

I would like to make the aquaculture farm more like a theme park to make it more interesting where people can fish for salmon, and where they can eat the salmon they catch in a gorgeous and beautifully prepared dish at a restaurant. It would be nice to have a place like an aquarium where we can explain the feeding of the salmon, and where people can experience feeding the fish.

This could help to solve the problems of aging fish farms and the lack of successors, which is an issue in Japan today. Fish farms are very costly and hard work. I would like to see fish farmers not only compete on the basis of price but also on the basis of brand value and sell their fish appropriately. That is what I would like to do.

# Any advice for women who want to be sushi chefs or fish farmers/entrepreneurs?

First of all, please think about carefully "what kind of fish is your ideal fish?" and "what kind of sushi is it?" Then, please think about whether the sushi and fish you produce will last for 100 years. If you can do that, you have won. Many business models struggle there. Then, talk about that concept, talk to people around you, how you can make it happen, and most important – don't give up! I hope you will not give up and do your best to achieve your final goals.

### **SEE ALSO**

Harris, D. A., & Giuffre, P. 2015. Taking the heat: Women chefs and gender inequality in the professional kitchen. Rutgers University Press.

# Why should SIDS participate in **Blue Transformation** through better aquaculture?

The SOFIA 2022 (FAO, 2022a) and other publications L have documented success in aquaculture development on a global scale as aquaculture has exceeded projections and keeps growing (FAO, 2022a; Asseng et al., 2021; Delago et al., 2003), however the Small Island Developing States (SIDS) have not shared in this growth (Figure 1). The history of aquaculture in SIDS demonstrates the common challenges to aquaculture development, as well as showcases specific challenges unique to SIDS. As such, aquaculture in SIDS would benefit from special attention (FAO, 2017; FAO, 2022b: indeed the only explicit reference to aquaculture in the Sustainable Development Goals, number 14.7, is specific to SIDS. To this effect, FAO's Blue Transformation vision aims at the aquatic food system, with one of the three objectives being to promote sustainable aquaculture intensification and expansion to satisfy global demand for aquatic food and distributing its benefits equitably (FAO, 2022c), something of potential relevance to the SIDS.

SIDS are a heterogeneous group of countries, areas and territories which nevertheless importantly share several key characteristics and challenges to aquaculture development. Among these challenges is their fragile environmental exposure to extreme weather conditions, primarily storms, which impose high risks to aquaculture ventures. Additionally, SIDS can also be vulnerable to economic shocks.

Distance from markets, long supply chains and limited connectivity make transport costs high and variable, both increasing the cost of production with expensive imports and increasing the break-even point, which can obstruct growth in SIDS. On the other hand, many SIDS have pristine marine waters largely untouched by epidemic aquaculture diseases, which has gained the interest of foreign aquaculture companies to conduct grow-out operations in these waters. At the same time, the relatively low population sizes in SIDS suggest limited human and financial resources for complex and resource-intensive initiatives. The limited land area constrains inland and coastal aquaculture, and what land exists is threatened further by climate change and sea level rise. Limited local markets, combined with the difficulty in accessing or competing in international markets, have obstructed aquaculture in SIDS from fulfilling commercial expectations, with competition with imports of low-cost cultured fish being an additional obstruction (FAO, 2017).

Of the 40 FAO Members from SIDS, 35 have reported aquaculture production in the FAO statistics (FAO, 2023),

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and in 2021 this number dropped to 32. These SIDS are often grouped by geographic location:

- → The AIS Group (Atlantic Ocean, Indian Ocean and the South China Sea) includes Cabo Verde, Comoros, Guinea-Bissau, Maldives, Mauritius, Sao Tome and Principe, Seychelles, and Singapore.
- → The Caribbean Group includes Antigua and Barbuda, Bahamas, Barbados, Belize, Cuba, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, and Trinidad and Tobago.
- → The Pacific Group includes Cook Islands, Fiji, Kiribati, Marshall Islands, Micronesia, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tokelau (Associate Member), Tonga, Tuvalu, and Vanuatu.

Figure 2 displays aquaculture production in the three subgroups.

Cuba was the first SIDS to start reporting aquaculture activities to FAO, beginning in 1967 with marine aquaculture where they produced 20 tonnes of mangrove cupped oyster (*Crassostrea rhizophorae*), and with freshwater aquaculture in 1973 where 10 tonnes of blue tilapia (*Oreochromis aureus*) were produced. Singapore became the first SIDS to begin reporting aquaculture in brackish water in 1970, with 10 tonnes of banana prawn (*Penaeus merguiensis*).



From the mid-1980s, aquaculture grew faster in SIDS than the global average until 1999, at which time production in SIDS peaked at 79 980 tonnes (about 0.2 percent of global aquaculture production). Since then, SIDS have not contributed to the large expansion of global aquaculture production in the 2000s and 2010s (FAO, 2022a). In 2020, aquaculture production in SIDS yielded the lowest volume since 1996 (Figure 2) and rebounded by 6 percent in 2021 to 56 608 tonnes.

When SIDS produced 57 268 tonnes with aquaculture in 2003, the farm gate value was USD 141.9 million, representing USD 2.62 per kg produced. In 2021 the estimated farm gate value of the 56 608 tonnes was USD 114.5 million representing USD 2.03 per kg produced with aquaculture. From 2003 to 2021, SIDS aquaculture production of shrimp shrank by 9 843 tonnes, mussels by 2 598 tonnes and miscellaneous freshwater fishes by 2 457 tonnes.

The SIDS have seen decreasing aquaculture production since 2014, following a downward trend since 2000, despite efforts to boost aquaculture (FAO, 2017; Dabbadie and Stankus, 2017; Alder *et al.*, 2018). Since 2001, aquaculture production in SIDS has plateaued between 50 000 and 70 000 tonnes (around 0.04 and 0.06 percent of global production).

Table 1 gives an overview of major aquaculture species in SIDS in 2021 by production environment. Although many SIDS have scarce freshwater resources (FAO, 2017), freshwater aquaculture has been a leading contributor to aquaculture production in SIDS since the 1990s, particularly in Cuba, Dominican Republic, Haiti, and Papua New Guinea. Haiti, Papua New Guinea and Singapore), where 74 percent of SIDS inhabitants live, generated 68 percent of SIDS total aquaculture production.

While SIDS have gone through erratic aquaculture development, from the 1990s to 2021 their marine fisheries expanded with a growth of 191 percent – a rate far exceeding the total world marine fisheries which grew by 1.8 percent (from 79.6 million to 81 million). As SIDS increased their capture production, the impetus to grow more fish through aquaculture may have been reduced (Goldburg and Naylor, 2005) compared to rates seen on a global scale. Aquatic food imports have partially satisfied demand for seafood, especially in Caribbean SIDS (FAO, 2017). Capture fishery production of SIDS has reduced by 118 thousand tonnes from its 2019 peak, with the decline in capture fisheries potentially leading to an increase in aquaculture-focused initiatives in SIDS to support food security (Teneva *et al.*, 2023).

## **Aquaculture in Caribbean SIDS**

Caribbean SIDS produced 49 thousand tonnes through aquaculture in 1999 and again in 2009. In 2021 the production fell to 28 988 tonnes. The farm gate value of Caribbean SIDS aquaculture production was estimated to be USD 57.8 million in 2021. Most aquaculture in Caribbean production comes from cultivation of carps in freshwater in Cuba. Cuba was the sole aquaculture producer among Caribbean SIDS from 1967 to 1977, and in 2021 accounted for 78 percent of total Caribbean aquaculture production. Cuba's focus has shifted from one species to another both in freshwater aquaculture – from channel catfish (*Ictalurus punctatus*) to North African catfish (*Clarias gariepinus*) (FAO, 2023) – and in coastal aquaculture – from Southern white shrimp (*Litopenaeus schmitti*) to whiteleg shrimp (*Penaeus vannamei*). Extended droughts and more frequent

The five most populous SIDS (Cuba, Dominican Republic,

 TABLE 1 – SIDS major aquaculture produced species, by environment and major producers, 2021

SIDS Major Aquaculture produced species by production environment, 2021	Tonnes	Percent	Major producer of specie
Brackishwater production	6 362	11.2	
Whiteleg shrimp, Penaeus vannamei	5 675	89.2	Cuba
Nile tilapia, Oreochromis nioticus	250	3.9	Haiti
Penaeus shrimps nei, <i>Penaeus</i> spp	128	2	Guyana
Groupers nei, <i>Epinephelus</i> spp	75	1.2	Singapore
Indo-Pacific swamp crab, Scylla serrata	42	0.7	Singapore
Other	192	3	
Freshwater production	24 337	43	
Silver carp, Hypophthalmichthys molitrix	12 000	49.3	Cuba
Nile tilapia, Oreochromis nioticus	4 391	18	Papua New Guinea
North African catfish, Clarias gariepinus	3 204	13.2	Cuba
Common carp, <i>Cyprinus carpio</i>	1 701	7	Cuba
Tilapias nei, Oreochromis spp	712	2.9	Dominican Republic
Other	2 330	9.6	
Marine production	25 910	45.8	
Elkhorn sea moss, Kappaphycus alvarezii	16 770	64.7	Solomon Islands
Red drum, Sciaenops ocellatus	2 216	8.6	Mauritius
Milkfish, Chanos chanos	1 217	4.7	Cuba
Mangrove cupped oyster, Crassostrea rhizphora	1 042	4	Timor-Leste
Eucheuma seaweeds nei, Eucheuma spp	999	3.9	Singapore
Other	3 667	14.2	
SIDS Total Aquaculture production, 2021	56 608		

The portion of aquaculture environment of total aquaculture production in SIDS and the portion of selected species of aquaculture production in certain environments. Source FAO. 2023. Fishery and Aquaculture Statistics. Global aquaculture production 1950–2021 (FishStatJ). In: FAO Fisheries and Aquaculture Division [online]. [Cited 18 April 2023]. Rome. Updated 2023. https://www.fao.org/fishery/en/statistics/software/fishStatj

### TABLE 2 – Selected species in Caribbean SIDS Aquaculture

Country	Type of aquaculture	ASFIS Specie	Peak year	Peak production Tonnes	2021 production Tonnes	Change from peak production
Belize	Freshwater	Tilapias nei, Oreochromis spp	2008	1 865	70	-1 795
Belize	Brackishwater	White leg shrimp, Penaeus vannamei	2004	11 040	530	-10 510
Cuba	Freshwater	North African catfish, Clarias gariepinus	2015	7 746	3 204	-4 542
Cuba	Freshwater	Common carp, Cyprinus carpio	2016	1 726	1 041	-685
Cuba	Freshwater	Silver carp, Hypophthalmichthys molitrix	1999	27 267	12 000	-15 267
Cuba	Freshwater	Blue tilapia, Oreochromisaureus	1990	3 733	368	-3 365
Cuba	Marine	Mangrove cupped oyster, <i>Crassostrea</i> rhizophorae	1998	2 282	1 037	-1 245
Cuba	Brackishwater	White leg shrimp, Penaeus vannamei	2019	6 657	4 725	-1 932
Dominican Republic	Freshwater	Cichlasoma nei, <i>Cichlasoma</i> spp	2002	1 318	0	-1 318
Dominican Republic	Freshwater	Tilapias nei, Oreochromis spp	1994	1 278	620	-658
Haiti	Freshwater	Nile tilapia, Oreochromis niloticus	2021	1 475	1 475	0
Jamaica	Freshwater	Nile tilapia, Oreochromis niloticus	2006	7 543	869	-6 674
Total				73 930	25 939	-47 991

*Source*: FAO. 2023. Fishery and Aquaculture Statistics. Global aquaculture production 1950–2021 (FishStatJ). In: FAO Fisheries and Aquaculture Division [online]. [Cited 18 April 2023]. Rome. Updated 2023. https://www.fao.org/fishery/en/statistics/software/fishstatj

hurricanes have induced the decline in Cuba's aquaculture production (van der Heiden and Batista, 2020). Notably, the production of silver carp (*Hypophthalmichthys molitrix*) in Cuba has fallen significantly from 27 267 tonnes in 1999 to 12 000 tonnes in 2021. In Belize, the cultivation of whiteleg shrimp (*Penaeus vannamei*) in brackish water suffered from acute hepatopancreatic necrosis disease (AHPND) in 2015 and 2016, collapsing the production down to 500 tonnes in 2017–2020, a decline of 95 percent since 2004 (UNCTAD, 2018). Incidences such as these have affected aquaculture production in more SIDS. **Table 2** compares peak aquaculture production of selected important species for aquaculture of Caribbean SIDS to 2021 production levels.

# Aquaculture in Pacific SIDS

The aquaculture of Pacific SIDS is dominated by marine aquaculture which, since 2010, exceeds 10 000 tonnes annually and is mostly comprised of seaweed, measured in wet weight. The farm gate value of Pacific SIDS aquaculture production was estimated to be USD 11.1 million in 2021. Aquaculture of Pacific SIDS peaked in 1999 at 26 443 tonnes, while in 2021 the production amounted to 20 023 tonnes. Most aquaculture production of aquatic animals by Pacific SIDS comes from freshwater aquaculture (97 percent). The Solomon Islands emerged as major producer in Pacific SIDS in the 2010s and accounted for 62 percent of production in 2021. The Solomon Islands experienced a 126 percent increase of elkhorn sea moss (Kappaphycus alvarezii) aquaculture production in 2021, rising to a record level of 12 456 tonnes. This production increase in Solomon Islands contributed largely to offsetting the decreasing trend of aquaculture production in SIDS overall. Eucheuma seaweeds nei (*Eucheuma* spp.) aquaculture production decreased in Pacific SIDS from 15 090 tonnes in Fiji in 1999 to 250 tonnes in 2003, whose decline has been attributed to poor marketing arrangements for export alongside epiphytic filamentous algae, ice-ice disease and diebacks disease outbreaks which resulted in collapsing number of seaweed farmers (Sulu et al. 2004). Its production has fluctuated since and in 2021 had decreased further to 73 tonnes. Table 3 compares peak aquaculture production of selected important species for aquaculture of Pacific SIDS to 2021 production levels. Similarly, Kiribati's production of Eucheuma ceased entirely in 2021, from a peak of 11 174 tonnes.

# Aquaculture in AIS SIDS

Most of aquaculture in the AIS group is produced in marine water. Singapore was the largest producer at 69 percent of the AIS total in 2021, and was the only producer from 1970 to 1976. The AIS SIDS produced 9 720 tonnes in 2006, 9 108 tonnes in 2019, and 7 597 tonnes in 2021. The farm gate value of AIS SIDS aquaculture production was estimated to be USD 45.5 million in 2021. Mauritius produced 2 216 tonnes of red drum (*Sciaenops ocellatus*) and Singapore produced 1 216 tonnes of Milkfish (*Chanos chanos*) in 2021. The prawn farm that was established in Seychelles in 1989 ceased operation in 2008 (Hecht, 2013), but the farm was relaunched in late 2022 (Nicette, 2023). Table 4 compares peak aquaculture production of selected important species for aquaculture in AIS SIDS to 2021 production levels.

TABLE 3 – Selected species in Pacific SIDS aquaculture

Country	Type of aquaculture	ASFIS Specie	Peak year	Peak production Tonnes	2021 production Tonnes	Change from peak production
Fiji	Marine	Eucheuma seaweeds nei, Eucheuma spp	1999	15 090	73	-15 017
Kiribati	Marine	Eucheuma seaweeds nei, Eucheuma spp	2000	11 174	0	-11 174
Timor-Leste	Marine	Eucheuma seaweeds nei, Eucheuma spp	2010	1 500	700	-800
Papua New Guinea	Marine	Elkhorn sea moss, Kappaphycus alvarezii	2021	4 300	4 300	0
Papua New Guinea	Freshwater	Nile tilapia, Oreochromis niloticus	2021	1 320	1 320	0
Solomon Islands	Marine	Elkhorn sea moss, Kappaphycus alvarezii	2021	12 456	12 456	0
Total				45 840	18 849	-26 991

Source: FAO. 2023. Fishery and Aquaculture Statistics. Global aquaculture production 1950–2021 (FishStatJ). In: FAO Fisheries and Aquaculture Division [online]. [Cited 18 April 2023]. Rome. Updated 2023. https://www.fao.org/fishery/en/statistics/software/fishstatj

### **Possible path for SIDS**

aquaculture demands predictable conditions, As actors located in areas that are prone to suffer extreme meteorological conditions as many SIDS are, may struggle to develop aquaculture. There is a need to understand the risk management, local demand and seasonal supply gaps of aquaculture in SIDS. The small size of SIDS, with limited infrastructure, affords little capacity to adapt and deal with shocks, whether they are economical through key players leaving, biological through disease outbreaks, or meteorological through droughts, storms or inundation. Emerging technologies have made training and capacitybuilding more accessible. The focus on the role of aquatic foods in SIDS through the SDGs, including aquaculture, has increased awareness and can facilitate much needed investment. SIDS can participate in Blue Transformation and serve more balanced aquaculture globally (Cai and Leung, forthcoming) through species selection among other options.

It is clear that the potential to increase aquaculture production in SIDS exists. At the same time, there is a need for more accurate and precise reporting, especially noting the paucity of data for remote islands. (FAO, 2017). Intensifying aquaculture activity of relevant selected species for SIDS by applying appropriate innovative technologies for improved biosecurity, enhanced resilience and appropriate marketing and methods may facilitate better access to aquatic foods and seafood markets. This may include heeding the call for development of aquaponics in SIDS (FAO, 2022c). Joint initiatives can help Blue Transformation in SIDS. Securing future resilient and sustainable aquaculture might include research, specific policy and investment with aims to:

- → approach, if not match, previous peak levels;
   → allow the support of healthy diets and food security; and
- $\rightarrow$  increase value creation in SIDS to support livelihoods.

### TABLE 4 – Selected species in AIS SIDS aquaculture

Country	Type of aquaculture	ASFIS Specie	Peak year	Peak production Tonnes	2021 production Tonnes	Change from peak production
Mauritius	Marine	Red drum, Sciaenops ocellatus	2020	3 224	2 216	-1 008
Seychelles	Brackishwater	Giant tiger prawn, Penaeus monodon	2004	1 175	0	-1 175
Singapore	Marine	Green mussel, Perna viridis	2006	5 891	360	-5 531
Singapore	Marine	Barramundi(=Giant seaperch), Lates calcarifer	2019	1 197	840	-357
Singapore	Marine	Milkfish, Chanos chanos	2015	2 359	1 216	-1 143
Total				13 846	4 632	-9 214

*Source*: FAO. 2023. Fishery and Aquaculture Statistics. Global aquaculture production 1950–2021 (FishStatJ). In: FAO Fisheries and Aquaculture Division [online]. [Cited 18 April 2023]. Rome. Updated 2023. https://www.fao.org/fishery/en/statistics/software/fishstatj

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# Oyster farming in ancient Rome

A quaculture reached a high degree of development and popularity in the Roman Empire. Beyond a way of producing food or a whim of the wealthy classes, the cultivation of aquatic species was carried out as an activity with a clear commercial objective. The surviving references from classical authors on the practice of aquaculture offer abundant technical and social details. Of the numerous species cultivated, oysters were the most popular and on which the available information has allowed better study by modern scholars. The following paragraphs summarize some of the main features of oyster farming at that time.

Shellfish meat was considered a top delicacy among all marine products in ancient Mediterranean cultures. Among all the bivalve species, oysters were especially appreciated by the Romans, to the point that archaeology evidences a displacement from mussel consumption to oysters as Romanization advanced along the "*Mare Nostrum*" and beyond. The passion for oysters fuelled an active trade along the Empire and the development of extremely efficient systems for transportation and preservation of live oysters across considerable distances and durations. Oyster consumption appears as an evident sign of social distinction and wealth since the Late Republic (200 BCE) until the fall of the Western Empire (476 CE).

Oyster farming began in ancient Rome by the hand of Gaius Sergius Orata, a wealthy citizen in Campania, who is reported as the first man who settled artificial oyster beds, targeting the Roman high society market and making a good profit from it. Orata developed his business near Baiae and Puetoli, exploiting the distinctive environmental conditions of the brackish volcanic lagoons which provided the oysters a special taste. He successfully promoted the oysters from Lucrine Lake as a premiumquality food across the Roman high class. The debate about the behaviour of Roman fish farmers moves around as to whether fish farming was an expensive eccentricity or a profitable business. Pliny clearly states Orata entered in the oyster business "...not for the gratification of gluttony, but of avarice, as he contrived to make a large income by this exercise of his ingenuity", making clear that he had an evident lucrative motivation behind his farming activity. Pliny makes a distinction between Orata and other fish farmers who build up their ponds as a luxurious hobby to enlarge the lushness of their villas and banquets as had become popular in the Late Republican and Early Empire times.

Written by: José Fernández Polanco University of Cantabria, Spain



Ancient Roman fish farm in Sperlonga, Italy.

Orata would have developed his own farming technology, perhaps in an attempt to gain an advantage over competitors. He is reported to have invented warm-water ponds, installing a hypocaust system for heating the houses and villas below his oyster ponds. Thus, oyster farmers in Lucrine Lake used a production system based on debris beds with extended systems of poles and ropes, with differing results in terms of the shape, appearance and quality of the oysters. Ancient sources provide evidence supporting the idea that oyster exchanges among producers and consumers were in the form of market transactions. Until the Late Empire period, most oyster supply was under private control and free of governmental intervention. Price decisions in the oyster market were made freely and unregulated, based on production costs and demand size, corresponding to the dynamics of a market economy.

The main operational costs involved were based on the common production factors. Labour mainly involved seasonal free workers for maintenance and harvesting, while more critical tasks were left in the hands of freedmen or slaves, who usually were trained by the patron. Other costs include access rights and duties to be paid to the Imperial administration; seeds, when not produced in the farm; energy in the form of wood for heating; and services such as transport and retailing. The farms settled by Orata involved high investment in infrastructure and must have resulted in high depreciation rates. However, the Romans did not have a clear concept of capital depreciation beyond maintenance costs.

Oyster demand was driven by prices, incomes and substitution, with demand quantities changing as the price changed. However, high prices prevented lowincome citizens from consuming oysters. Oysters were a luxury product and consumption was strongly associated with consumers' disposable income. Demand was higher among wealthier consumers and would have risen in line with the citizens' incomes. Oysters may have been well-differentiated with regard to other shellfish, but substitution across different oyster categories cannot be rejected. Ancient sources provide enough information to assess that the price of oysters and other seafood products could vary according to intrinsic attributes such as size and shape, or extrinsic factors such as region of origin.

Transactions of oysters were part of a larger integrated market. Highly sophisticated transport routes and systems were developed to supply fresh and live oysters to the market in the area of Rome, involving a considerable number of resources and costs which were translated into the final retail prices. The most well-known, due to the celebrated quality of the oysters was the route from Britain, from which oysters arrived to Rome still alive – having used snow from the mountains to keep the water cold.

The business founded by Sergius Orata in early 1 BCE remained active for almost 200 years. Around 70 CE Pliny reports some kind of issue in Lucrine Lake which made farmers import the seeds from Brundisium, in the Adriatic. Collected from the wild, the seeds were stored in the lake for a period before sending to the market in Rome. Environmental or animal health issues may be behind



Oyster shells excavated from Roman ruins.

these operations, initiating the phase of decline for this business. The explosion of Vesuvius mons put a dramatic end to the oyster business in Lucrine Lake., with further explosions erasing any remains of the farming operations.

Oyster farming returned to be an active industry in Lucrine Lake in 3 CE, however oyster beds were no longer used. Instead, the pole and rope farming system became dominant and formed distinctive facilities of the villa of Puetoli. Emperor Diocletian fixed the maximum prices of a large number of commodities, which included oysters and other seafood products in 301 CE. Overall, the industry and trade collapsed as a consequence of decreased margins. Imperial institutions replaced private businesses progressively as economy moved into a market under government control. Small scale mussel farming remains today in the lake as a reminder of the ancient success of the Lucrine oysters.

Ancient Romans developed oyster farming with a clear commercial purpose, taking advantage of a product with a strong demand and high market value. Bridging the technological gap, oyster farming today shares many of the economic characteristics that defined the business principles of Roman oyster culture.

### **SEE ALSO**

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Improved aquaculture management in Kyrgyzstan improving the capacity of the sector to generate food, eployment and income for rural populations.



# Fernanda Garcia Sampaio

Fernanda joins FAO as a Fishery Officer, with a specific focus on aquafeed. She holds a bachelor's degree in animal science, a master's in animal nutrition, and a Ph.D. in vertebrate physiology.

Before joining FAO, Fernanda worked with aquatic organisms to determine nutritional requirements for better performance of tropical fish, and on environmental contamination issues and its effect on fish health and productivity. While working for the Brazilian Ministry of Fisheries and Aquaculture, she supported work on the planning and governance of aquaculture. During her time at EMBRAPA, an agricultural research institution in Brazil, she led research on fish farming, nutrition, and the environment. In nutrition research, her work focused on using essential oils and plant extracts for fish nutrition and health. In addition, she worked as the coordinator of climate change and sustainable agriculture in the Ministry of Agriculture, Livestock and Supply of Brazil.

At FAO, Fernanda works on aquafeed and climate change in aquaculture. Specifically, she is working to promote experts' discussion on alternative feed ingredients, feed management practices, and feed supply. Rrelatedly she is working on tools and strategies to improve aquaculture resilience to climate change.

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Mohamed El Sayed Megahed

Mohamed El Sayed Megahed was appointed to the position of Fisheries Officer (Mariculture) as of 4 February 2023. In this role he will focus on mariculture and digitalization of aquaculture. In regards to digitalization, this work will help to improve efficiency and management of energy, labour, automation, and other aquaculture practices while supporting aquaculture business development. Moreover, he is working in the African Hub to steer the development of aquaculture in Africa with innovative practices and in consultation with the private sector. Mr Megahed has extensive working experience in sustainable development of aquaculture supporting a broad category of stakeholders in Asia and Africa.

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Cooking Session with Michelin Star Chef Gianfranco Pascucci during the Forum on Fisheries Science in the Mediterranean and the Black Sea, showcasing culinary uses for aquatic foods.

# **Highlights**



# FAO 2023

International Year of Artisanal Fisheries and Aquaculture 2022. Final report - Rome

Fish, molluscs, crustaceans and aquatic plants are fundamental, essential and indispensable foods eaten by people around the world as part of healthy diets, cultural heritage and culinary tradition. Smallscale artisanal fisher and fish farmers produce a large portion of this food.

The International Year of Artisanal Fisheries and Aquaculture (IYAFA) 2022 was an opportunity to highlight the importance of small-scale artisanal fisheries and aquaculture for our food systems, livelihoods, culture and the environment.

This report provides a summary overview of the objectives, activities and recommendations of the IYAFA 2022. It aims to motivate relevant stakeholders to ensure that the end of the Year is the beginning of a new era of support for small-scale fisheries and aquaculture.

### The PDF can be accessed directly at: http://www.fao.org/3/cc5034en/cc5034en.pdf

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FAO 2023

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# Report of the Thirty-fifth Session of the Committee on Fisheries

– Rome

The Thirty-fifth Session of the Committee on Fisheries (COFI) was held in Rome, Italy, from 5 to 9 September 2022. This is a report of the Session reflecting the discussions which took place and containing all recommendations and decisions taken by the Committee. A synopsis of the outcome of the Session is presented in the abstract and all supplementary information is included in

the appendixes.

The PDF can be accessed directly at: http://www.fao.org/3/cc3652en/cc3652en.pdf The document card can be found here: https://www.fao.org/documents/card/en/c/cc3652en

# Fisheries and Aquaculture Technical Manuals

### FAO 2023



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Joint FAO-IOC-IAEA technical guidance for the implementation of early warning systems for harmful algal blooms – Rome

Globally, there are 3 400 to 4 000 described species of marine microalgae but only 1 to 2 percent are considered to be harmful. Harmful algal blooms (HABs) have significant impacts on food safety and security through contamination or mass mortalities of aquatic organisms. The impacts and mass mortalities of marine species caused by harmful algae are not new and have been recorded

for decades. However, there is growing concern that these events will increase due to accelerating global warming, climate change and anthropogenic activities. Indeed, if not properly controlled, aquatic products contaminated with HAB biotoxins are responsible for potentially deadly foodborne diseases and when rapidly growing, HAB consequences include reduced dissolved oxygen in the ocean, dead zones, and mass mortalities of aquatic organisms. Improving HAB forecasting is an opportunity to develop early warning systems for HAB events such as food contamination, mass mortalities, or foodborne diseases. Surveillance systems have been developed to monitor HABs in many countries; however, the lead-time or the type of data (i.e. identification at the species-level, determination of toxicity) may not be sufficient to take effective action for food safety management measures or other reasons, such as transfer of aquaculture products to other areas. Having early warning systems could help mitigate the impact of HABs and reduce the occurrence of HAB events. The Joint FAO-IOC-IAEA technical guidance for the implementation of early warning systems (EWS) for HABs will guide competent authorities and relevant institutions involved in consumer protection or environmental monitoring to implement early warning systems for HABs present in their areas (marine and brackish waters), specifically those affecting food safety or food security (benthic HABs, fish-killing HABs, pelagic toxic HABs, and cyanobacteria HABs). The guidance provides a roadmap for stakeholders on how to improve or implement an EWS for HABs and biotoxins, where appropriate. It is important to note that not all countries and institutions can implement the same level of EWS for HABs, and this guidance is intended mainly for those who seek to broaden existing early warning systems, or who are just beginning to consider putting a system in place.

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# FAO 2023

Caracterización de la pesca y la acuicultura artesanal en pequeña escala en América del Sur y recomendaciones de políticas públicas - Santiago

Esta publicación compila una serie de recomendaciones alineadas a las disposiciones y orientaciones de instrumentos internacionales para fortalecer la sostenibilidad de la pesca y acuicultura artesanal en pequeña escala, y que a su vez permitan mejorar las condiciones de vida de

pescadores y acuicultores artesanales de América del Sur.

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# Workshops reports



# FAO 2023

Report of the Expert Workshop on "Incorporating information on wild relatives of aquaculture species into an information system for aquatic genetic resources" - Rome

This report summarizes the proceedings and outcomes of the Expert Workshop on "Incorporating information on wild relatives of aquaculture species into an information system for aquatic genetic resources" held from 2 to 3 August

2022. The workshop aimed to discuss the expansion of the FAO Aquatic Genetic Resources Information System (AquaGRIS) in order to also include information on wild relatives (i.e. wild stocks) of aquaculture species. AquaGRIS, the system being developed by the FAO Fisheries and Aquaculture Division, will help countries and stakeholders to inventory national aquatic genetic resources (AqGR) used for aquaculture and monitor the status of their management.

The PDF can be accessed directly at: http://www.fao.org/3/cc3026en/cc3026en.pdf

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### FAO 2023

Report of the Regional Consultation for Europe and North America on the development of Guidelines for Sustainable Aquaculture (GSA), Virtual meeting, 27-29 April 2021 - Rome

This document represents the final report of the Regional Consultation for Europe and North America on the development of Guidelines for Sustainable Aquaculture (GSA), held virtually from 27 to 29 April 2021. The objectives of the

consultation were to: share current policies and practices related to aquaculture in the regions; review existing regional and national instruments for sustainable aquaculture; develop a list of priority thematic modules considering regional and national strengths and challenges; propose and prioritize possible case study concepts linked to one or more thematic modules; and identify regional priority areas to be included in the GSA.

The PDF can be accessed directly at: http://www.fao.org/3/cc3838en.pdf

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# FAO 2023

Proceedings of the EIFAAC symposium on inland fisheries and aquaculture: advances in technology, stock assessment and citizen science in an era of climate change. Killarney, Ireland, 20-21 June 2022 - Rome

The international symposium on "Inland Fisheries and aquaculture: advances in technology, stock assessment and citizen science in an era of climate

change" was organized in conjunction with the thirty-first session of the European Inland Fisheries and Aquaculture Advisory Commission in Killarney, Ireland on 20–21 June 2022. The symposium was organized by Inland Fisheries Ireland and the Department of the Environment, Climate and Communications.

The symposium was attended by 105 participants from 14 countries. The main documentation comprised six invited papers and 35 experience papers and 15 posters. The symposium had five major themes, which were: (i) Inland fish stock assessment, (ii) Developments in freshwater fish monitoring technologies with an emphasis on non-destructive methods, (iii) The problems and challenges of climate change and its impacts on inland aquatic resources and fisheries, (iv) Citizen science, and (v) Aquaculture - traditional freshwater systems vs recirculation systems. The symposium provided valuable networking opportunities for the participating scientists, especially young scientists could share their research findings. Many promising studies and innovative technologies and methodologies were presented. This Occasional Paper in conjunction with a special issue of Fisheries Management and Ecology represents the proceedings of the symposium.

The thirty-first session of EIFAAC, held in Killarney from 22 to 24 June 2022, discussed and endorsed the conclusions and recommendations from the symposium.

The PDF can be accessed directly at: https://www.fao.org/3/cc4931en/cc4931en.pdf

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### FAO 2023

Report of the Ninth Meeting of Regional Fishery Body Secretariats' Network - Rome, 2, 3 and 9 September 2022 -Rome

The Ninth Meeting of the Regional Fishery Body Secretariats' Network (RSN-9) brought together Secretariats of regional fishery bodies (RFBs) with diverse mandates from all geographic regions, including FAO and non-FAO regional fishery bodies, marine and inland fishery advisory and

management bodies and agreements, the United Nations Division for Ocean Affairs and the Law of the Sea (DOALOS), the Convention on Biological Diversity (CBD), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the United Nations Environment Programme (UNEP) and other invited organizations. RSN-9 took place immediately before and after the Thirty-fifth Session of the Committee on Fisheries (COFI-35), which was held from 5 to 9 September 2022. As was the case with COFI, RSN-9 met in hybrid format, in person and virtually, via videoconference, to facilitate the participation of those who could not assist personally. For the first time, the meeting was convened over three days. The meeting allowed participants to exchange views and discuss global processes of particular relevance to RFBs. In addition, RSN-9 provided the opportunity to discuss the development and strengthening of RSN, which included the adoption of the RSN terms of reference and the subsequent amendment of the RSN rules of procedure, as well as a space for reflection on the outcomes of COFI 35 and their implications for regional fishery bodies. The meeting had a high level of participation, which underlined the role of the Network as a unique forum to foster cooperation, facilitate discussion and share experiences.

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# **FAO Circulars**



### FAO 2022

FAO, Worldfish, University of Greenwich 2022 – Socio-economic and biological impacts of the fish-based feed industry for sub-Saharan Africa – Rome

As populations grow and urbanize, demand also increases for animal-source foods, including farmed livestock and fish, and for feed products that can include fish-derived ingredients. Lowand middle-income countries are increasingly

concerned about the fish-derived ingredient and fish-based feed industry, as many of the fish species used for fish-derived ingredients and fish-based feed production are important for communities as a source of livelihoods and food and nutrition security. The objective of this study was to understand the drivers, outcomes, and trade-offs of the fish-based feed industry for sub-Saharan Africa. The study, using various information sources and mixed methods for data collection and analysis, found that fish-based feeds are mainly exported, offering some economic benefits to governments and fish workers throughout the value chain. At the same time, however, the study results suggest that the industry constitutes a threat to the livelihoods and food and nutrition security of local communities. Looking to the future, a range of actions that are required to ensure that the fish-based feed industry contributes to equitable social and economic development, nutritional benefits, and environmental sustainability were identified. Using a stakeholder Delphi assessment, the study prioritized recommendations for decision-making and future research and these included the establishment of and/or compliance with regulations for environmentally friendly and healthy/safe fish-derived ingredients and fishbased feed production, as well as continued efforts to identify and promote alternative efficient to use feed products that do not rely (or rely less on) fishbased ingredients.

The PDF can be accessed directly at:

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### FAO 2023

Analyse des marchés des produits de la pêche et de l'aquaculture continentales dans les pays du Maghreb – *Tunis* 

Avec une production annuelle denviron 41 000 tonnes, la contribution des secteurs de la pêche continentale et de laquaculture reste modeste par rapport au potentiel hydrique et biologique de la région du Maghreb. Pourtant, ce secteur pourrait soutenir le développement de loffre alimentaire et contribuer à la lutte contre la pauvreté. Dune part,

il constitue une source d'alimentation et de revenus pour les petits producteurs qui exploitent les différents milieux aquatiques, et d'autre part, il peut être intégré à d'autres activités terrestres telles que l'agriculture. Cette combinaison d'activités permettrait une utilisation optimale des ressources disponibles dans une logique d'économie circulaire.

La pêche continentale et l·aquaculture sont de même nature dans les pays du Maghreb. Cependant, le niveau de développement de ces activités reste différent d/un pays à l·autre, malgré la présence de potentialités intéressantes. En outre, les espèces élevées dans les eaux continentales souffrent d/une faible popularité sur les marchés domestiques et restent des produits inconnus dans la majorité des ménages.

L'objectif de ce travail est, d'une part, de dresser un état des lieux comparatif de la situation de la pêche continentale et de l'aquaculture dans quatre pays du Maghreb (Algérie, Maroc, Mauritanie et Tunisie), en mettant l'accent sur l'offre, la demande, le développement et la commercialisation, et d'autre part, de proposer des pistes d'amélioration pour développer les marchés des produits de ces activités.

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### FAO 2023

Recomendaciones de políticas públicas para el desarrollo sostenible de la pesca y la acuicultura artesanales en pequeña escala en América del Sur. Lineamientos de políticas para las autoridades -Santiago

El presente documento fue preparado con el objetivo de realizar recomendaciones de política pública para el fortalecimiento de la pesca y la

acuicultura artesanales en pequeña escala en América del Sur y está dirigido a las autoridades nacionales de pesca y acuicultura en los países de la región. Estas recomendaciones se basan en la caracterización de estos sectores realizada en el marco del plan de trabajo del Año Internacional de la Pesca y la Acuicultura Artesanales.

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### FAO 2023

Recomendaciones para el desarrollo sostenible de la pesca y la acuicultura artesanales en pequeña escala en América del Sur. Lineamientos de políticas para hombres y mujeres que trabajan en el sector – Santiago

Este documento va dirigido a las personas que día a día trabajan en la pesca y la acuicultura artesanales en pequeña escala en América

del Sur, hombres y mujeres que permiten que tengamos alimentos sanos y nutritivos, y que contribuyen a la seguridad alimentaria y al desarrollo local. Se presentan los lineamientos que fueron elaborados en base a conversaciones, entrevistas y reuniones con actores relevantes de la pesca y la acuicultura, con el fin de caracterizar el sector, identificar sus principales desafíos y realizar recomendaciones para su fortalecimiento. Esta publicación se enmarca en el Año Internacional de la Pesca y la Acuicultura Artesanales (AIPAA 2022), que fue establecido por las Naciones Unidas para sensibilizar à la opinión pública y a los gobiernos sobre la importancia de adoptar políticas públicas de apoyo a los pequeños productores y productoras. En este esfuerzo, la FAO actúa como organismo líder, en colaboración con otras instituciones y órganos de las Naciones Unidas. Todas las recomendaciones para el fortalecimiento del sector se basan en los pilares del Plan de acción mundial del AIPAA y en instrumentos internacionales, como los Objetivos de Desarrollo Sostenible (ODS) y las Directrices voluntarias para lograr la sostenibilidad de la pesca en pequeña escala en el contexto de la seguridad alimentaria y la erradicación de la pobreza (Directrices PPE).

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# Raising the visibility of aquaculture through FAO STORIES

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The Northeast Peru Mangroves Consortium members monitor and manage their resources, maintain biodiversity and forest cover, run an eco-tourism business and a seafood processing unit in response to decreasing fisheries catches in the mangrove forests. They also conduct educational campaigns and <u>participate in scientific</u> <u>research to restock depleted species</u>, conducting small-scale aquaculture working with a private biotechnology lab for sustainable development.

Read the FAO Story here: www.fao.org/fao-stories/article/en/c/1641285/

akeshore development, pollution, climate change and overfishing have taken a heavy toll on the lake's biodiversity, including carp and other fish stocks, and that's affected the lives and livelihoods of those who depend on them.

Now, around 420 fishers are taking part in an FAO initiative, implemented together with Albania's Ministry of Agriculture and Rural Development, a local fishery management organization and non-governmental organisations (NGOs), to improve sustainable fishing practices and rebuild breeding stocks by using aquaculture-based practices.

Read the FAO Story here: www.fao.org/fao-stories/article/en/c/1618554/





FAO Fisheries and Aquaculture Division Natural Resources and Sustainable Production Stream Email: NFI-Inquiries@fao.org Food and Agriculture Organization of the United Nations Rome, Italy

A s part of the Global Conference on Aquaculture Millennium +20, nine Thematic Reviews were prepared under the overall guidance of the International Programme Committee, with the objective to review and update the current understanding on key issues relating to the development of sustainable aquaculture.

A group of experts prepared advanced working drafts of each Thematic Review and the key findings from each theme were presented and discussed by expert panels during the GCA +20.

Aquaculture

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Eight of the nine Thematic Reviews have been published in May 2023 as a special issue of the **Journal of the World Aquaculture Society** (Volume 54, Issue 2) in open access format. The individual articles including an editorial, can be downloaded here Journal of the World Aquaculture Society

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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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