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FAO Aquaculture News



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Towards Blue Transformation: Aquaculture in a changing world

2022: A unique and busy year!

We celebrated the International Year of Artisanal Fisheries and Aquaculture (IYAF), we successfully conducted the Thirty-fifth Session of the Committee of Fisheries (COFI 35) as a hybrid (in person/virtual), and we held the Eleventh Session of the Sub-Committee of Aquaculture (COFI:AQ) in virtual modality for the first time. This year, FAO also participated in the UN Ocean Conference, during which FAO launched *The State of World Fisheries and Aquaculture* for the first time outside of FAO headquarters. There are too many big events to name them all here, but suffice it to say, 2022 has been busy.

We are happy to see several aquaculture initiatives endorsed by the FAO Council and COFI 35, such as the Science and Innovation Strategy, the Global Plan of Action for Aquatic Genetic Resources, the launch of the Global Registration Information System of Aquatic Genetic Resources, the progress on aquaculture biosecurity and antimicrobial resistance control, and the progress on the Guidelines for Sustainable Aquaculture (GSA).

In support of national actions on aquaculture development, FAO continues to provide technical support to Members through consultation, project scoping and proposal preparation, and implementation.

FAO is also supporting the collection and sharing of knowledge and success stories in sustainable aquaculture development through implementing the Global Sustainable Aquaculture Advancement Partnership (GSAAP), which will improve global and regional networking for aquaculture, strengthen capacity building for aquaculture stakeholders, and develop and disseminate new knowledge products.

Some other major work areas include policy dialogues on seaweed aquaculture, a high-level meeting on aquaculture transformation in the Asia-Pacific region, participation at the World Aquaculture Society and European Aquaculture Society events, and regional workshops on aquaculture for food security in water-scarce regions.

FAO's new Blue Transformation Roadmap will guide the implementation of sustainable aquaculture growth and development, with clearly defined objectives to intensify and expand global aquaculture production, particularly in less developed regions, in order to support the healthy and nutritious aquatic food system transformation, as well as to develop the fishery community economy, increase employment and enhance participation of women and youth.

Accomplishing these results has engaged colleagues across the FAO family, all of whom are duly recognized

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COVER PHOTO:

Top: Integrated agriculture model under the sufficiency economy philosophy (SEP) at Ban Nong Kham, Nai Muang Sub-District, Wiang Kao District, Khon Kaen, Thailand. ©FAO/K. Hampitak. – Bottom left: Tilapia hatchery in Eastern region of Saudi Arabia. ©FAO. – Bottom right: Harvesting and monitoring seaweed. ©FAO/G. D'Cruz.



for their hard work, efficiently and effectively striving to deliver FAO's mandate. The Fisheries and Aquaculture Division has experienced a restructure in the past few years, and with this new structure, aquaculture teams are more agile and prepared to face the challenges of the changing world. In 2022, we have welcomed new colleagues with energetic faces, and seen old friends and colleagues retire to their second journey in life. To each and every one, we wish the very best.

2023: The mission continues

2023 is coming, and with it continuing work and new initiatives on the horizon.

The Twelfth Session of the Sub-Committee on Aquaculture will be hosted by the Government of Mexico from 7 to 10 March, and we hope to see all delegates in person for a physical meeting, the first after four years. FAO looks forward to presenting the GSA, reflecting the intense intersessional efforts of the COFI:AQ Bureau, Members, taskforce participants and the wide FAO team.

Under the FAO Science and Innovations Strategy, Members have emphasized the need to harness science, technology, and innovation to drive the transformation of agrifood systems. Absolutely, this holds true for fisheries and aquaculture, as science and innovation are fundamental for increasing productivity while building resilience to climate change and protecting natural resources. FAO's aquaculture group continues to highlight the importance of information and communication technology, cooperate with academia and innovation institutes, and enable new technologies to reach their full potential in advancing the aquaculture sector.

Relatedly, FAO is supporting GSAAP, welcoming interested stakeholders to become partners involved in fisheries and aquaculture. On the topic of partnerships, it is only by working together that the global community can address the urgent and significant challenges, so desperately needed to achieve the Sustainable Development Goals.

All partners are encouraged to support the Hand-in-Hand initiative and the One Country One Priority Product initiatives, especially where they concern fisheries and aquaculture. Working together, leveraging the global expertise through matchmaking, and advancing South-South and Triangular Cooperation will further enhance partnerships with institutions, together contributing towards a world in which aquaculture makes its contribution to food security and nutrition, employment opportunities, rural economic development, and to the wider Sustainable Development Goals.

FAO will also support through a review of the ecosystem approach to aquaculture, with the goal to improve understanding of aquatic ecosystems, the factors influencing carrying capacity, biodiversity and production, and making use of the best available science and technology. Relatedly, innovative governance, notably aquaculture zoning, can be used to further enhance the sustainability of aquaculture.

This transformation requires commitment from all stakeholders. To achieve the goals of the sector, investment is a key aquaculture development subsector for a Member country's aquaculture growth, including infrastructure, input of seed, feed and chemicals, research and development, and business development. As such, the development community, the private sector and financial institutions will need to work together.

In the coming New Year 2023, we will continue to work together, building strong global and regional processes and partnerships, providing practical support to national aquaculture development, and making use of science and innovation to achieve better production, better nutrition, a better environment, a better life, and leave no one behind.

Written by

Yuan Xinhua

Deputy Director

FAO Fisheries and Aquaculture Division, Rome, Italy



Indigenous farmer in the Kalinago territory, Dominica, using a spring-fed pond for prawn culture.

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Healthy rice nearing maturity in an integrated agriculture aquaculture paddy in China.

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COFI Sub-Committee on Aquaculture Sessions XI and XII



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At the Eleventh Session of the Sub-Committee on Aquaculture, the Chairperson, Mr Belemane Semoli of South Africa, and the Secretary, Mr Matthias Halwart, work together to facilitate its first-ever virtual Session.

The Sub-Committee – a unique intergovernmental aquaculture forum

Compared to other statutory bodies, the FAO Committee on Fisheries (COFI) Sub-Committee on Aquaculture (COFI: AQ) is relatively young. The participants of the FAO/NACA Global Conference on Aquaculture in 2000 jointly developed the Bangkok Declaration and Strategy for Aquaculture Development Beyond 2000 with a strong call for regional and interregional cooperation, noting that “there are issues relevant to aquaculture development that require a strong global focus to be addressed and that this need might best be achieved by establishing a global intergovernmental forum within an appropriate existing international organization, having sustainable aquaculture development as its primary focus and with a mandate for discussion, decision, and agreement on technical and policy matters.” Following an Expert Consultation organized by FAO’s Aquaculture Service, FAO Members

fully agreed to the recommendation and established COFI: AQ at COFI’s Twenty-fourth Session in 2001 with membership open to all Members of the Organization. COFI: AQ held its first session in Beijing, China, 18–22 April 2002, with the terms of reference stipulating that “The Sub-Committee shall provide a forum for consultation and discussion on aquaculture and advise COFI on technical and policy matters related to aquaculture and on the work to be performed by the Organization in the subject matter field of aquaculture.” In particular, it was agreed that COFI: AQ shall identify and discuss major issues and trends in global aquaculture development; determine those issues and trends of international importance requiring action to increase the sustainable contribution of aquaculture to food security, economic development and poverty alleviation; and recommend international action to address aquaculture development needs. In the coming years, COFI: AQ fulfilled its role with sessions being convened at the invitation of FAO Members from different regions.

Written by:

Matthias Halwart

*Technical Secretary, COFI Sub-Committee on Aquaculture
FAO Fisheries and Aquaculture Division, Rome, Italy*

Highlights of Session XI, 24–27 May 2022 (virtual)

Because of the prevailing pandemic situation, the Eleventh Session of the Sub-Committee on Aquaculture of the FAO Committee on Fisheries was held virtually in Rome,

Session	Year	Location
1	2002	Beijing, China
2	2003	Trondheim, Norway
3	2006	New Delhi, India
4	2008	Puerto Varas, Chile
5	2010	Phuket, Thailand
6	2012	Cape Town, South Africa
7	2013	St Petersburg, Russian Federation
8	2015	Brasilia, Brazil
9	2017	Rome, Italy
10	2019	Trondheim, Norway
11	2022	Rome, Italy (virtual)
12	2023	Ciudad Obregón, Mexico

Italy, from 24 to 27 May 2022. It had a record attendance of 107 FAO Members. Facilitated by the Chair Mr Belemane Semoli from South Africa, the Sub-Committee commended FAO's work during the intersessional period, including towards the International Year of Artisanal Fisheries and Aquaculture (IYAF), highlighted the importance of aquaculture and especially small-scale aquaculture for food security and nutrition, livelihoods, economic development and public health, and encouraged all Members to take action to further engage small-scale farmers. It welcomed the adoption of the Global Plan of Action for the Conservation, Sustainable Use and Development of Aquatic Genetic Resources for Food and Agriculture and of the FAO Strategic Framework and its "Blue Transformation" Programme Priority Area; noted the need to elaborate a clear strategy for the development of sustainable aquaculture; supported the further development of the draft Guidelines for Sustainable Aquaculture and asked FAO to consider them as a foundation for programmatic work; and emphasized the need for FAO's Global Integrated Sustainable Aquaculture Programme.

The Sub-Committee continues to recognize the value of the Code of Conduct for Responsible Fisheries, and supports the survey as a useful tool in identifying Members' needs as well as a broad indicator of progress over time. The Sub-Committee welcomed FAO's work on trade-related issues, underlined the importance of aquaculture for domestic consumption as well as the increasing importance of international trade for aquaculture products, and emphasized the importance of communication on aquaculture mainly to avoid consumer misconceptions. The Sub-Committee welcomed the agrifood systems approach to create pathways so that aquaculture adds to the resilience of the global agrifood system, and at the same time highlighted the susceptibility of aquaculture to shocks and emergencies. The Sub-Committee appreciated FAO's continued work on biosecurity and animal health, and encouraged the continued implementation of the Progressive Management Pathway for Improving Aquaculture Biosecurity. The Sub-Committee emphasized

the comparative advantage of most aquaculture to increase animal protein production with lower environmental and climate change impacts, and stressed the importance of cooperation and aquaculture networks for better resilience. The Sub-Committee congratulated FAO and the Network of Aquaculture Centres in Asia-Pacific (NACA) and the host, China, on the successful organization of the Global Conference on Aquaculture (GCA) Millennium +20. It noted the importance of the GCA as a regular and significant global platform to engage a broad range of stakeholders in aquaculture, recognized the value of the conference outputs and noted the success of the hybrid format. The Sub-Committee highlighted the important role that the growth of sustainable aquaculture must play in meeting the nutritional needs of a growing population and enhancing the resilience of global food systems.

The Sub-Committee noted with appreciation new examples of international cooperation, such as the International Artemia Aquaculture Consortium, the Center for Ecological Aquaculture and the Global Sustainable Aquaculture Advancement Partnership, and encouraged FAO to work in partnership with such initiatives to promote sustainable aquaculture, emphasizing the importance of the ecosystem approach to aquaculture and requesting technical assistance for its implementation. Finally, the Sub-Committee welcomed the kind invitation of Mexico to host the Twelfth Session, and of Türkiye and Indonesia to host its Thirteenth and Fourteenth Sessions, respectively.

Session XII coming up soon

With the above conclusions and recommendations in mind, COFI:AQ will meet again under the facilitation of Chair Edgar Edmundo Lanz Sánchez for its Twelfth Session from 7 to 10 March 2023 in Ciudad Obregón, Mexico. The agenda will once again be full, with the Secretariat reporting about important intersessional work, and important substantive agenda items covering a Special Event on *Women in Aquaculture – Challenges and Opportunities* on International Women's Day on 8 March 2023 and discussions on *Recognizing and Enhancing the Contribution of Algae to Global Aquaculture Development*.

Importantly, COFI:AQ XII will include Members' deliberations on the Guidelines for Sustainable Aquaculture (GSA), which were published as a draft on the GSA website (<https://www.fao.org/in-action/gsa/resources/en>) in September 2022 and will be open for a written commenting period by Members, followed by a Task Force meeting to be held virtually from 9 to 11 January 2023. The GSA process and timeline build on two Expert Consultations and regional consultations with many stakeholder inputs, and will also address the important recommendation from COFI:AQ XI to recognize the value of the GCA outputs – regional and global reviews, thematic reviews and the Shanghai Declaration – and carefully consider conclusions and technical recommendations of these outputs in the finalization of the GSA.

Aquaculture in SOFIA 2022

Zero hunger - Not on track

With 811 million people suffering from hunger and 3 billion not able to afford healthy diets, the world is far from its proclaimed goal of ending hunger and malnutrition in all its forms by 2030. A transformation of our agrifood systems is required, and the 2022 edition of *The State of World Fisheries and Aquaculture – Towards Blue Transformation* (SOFIA 2022) builds on exactly this concept, presenting evidence of the growing role of aquaculture in providing food, nutrition and employment.

Key messages

SOFIA 2022 underlines that: (i) aquaculture is at a record high with an increasingly important role in providing food and nutrition in the future; (ii) aquaculture growth must be sustainable and growth must go hand in hand with safeguarding ecosystems, reducing pollution, protecting biodiversity and ensuring social equity; (iii) the world's consumption of aquatic foods will increase further; (iv) building the resilience of vulnerable small-scale producers, especially women, is key to sustainability and equitable development; and (v) Blue Transformation can meet the twin challenges of food security and environmental sustainability but requires commitment from the public and private sectors if we are to achieve the United Nations 2030 Agenda for Sustainable Development.

Quantitative evidence

In 2020, global aquaculture production reached a record 122.6 million tonnes, including 87.5 million tonnes of aquatic animals worth USD 264.8 billion and 35.1 million tonnes of algae worth USD 16.5 billion. In terms of farming environments, around 54.4 million tonnes were farmed in inland waters and 68.1 million tonnes came from marine and coastal aquaculture.

We are eating more aquatic foods than ever – about 20.2 kg per capita in 2020 – more than double our consumption rate of 50 years ago. Globally, aquatic foods provide about 17 percent of animal protein, reaching over 50 percent in several countries in Africa and Asia. Production of aquatic animals in 2020 was more than 60 percent higher than the average in the 1990s, considerably outpacing world population growth, largely due to increasing aquaculture production. All regions, except Africa, experienced continued aquaculture growth in 2020. Africa experienced



Feeding tilapia on a farm in Padiegnan, a village included in the FISH4ACP project, Côte d'Ivoire.

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a decrease in the two major producing countries, Egypt and Nigeria, while the rest of Africa enjoyed 14.5 percent growth from 2019.

Asia continued to dominate world aquaculture, producing over 90 percent of the total. The contribution of aquaculture to the global production of aquatic animals reached a record 49.2 percent in 2020. Aquaculture of fed aquatic animals continues to outpace that of non-fed aquatic animals. Out of a great diversity of more than 650 farmed aquatic species/items, a small number of “staple” species dominate aquaculture production, particularly grass carp for global inland aquaculture and Atlantic salmon for marine aquaculture.

Out of an estimated 58.5 million people in primary fisheries and aquaculture production, 20.5 million (35 percent) were employed in aquaculture – 28 percent being women. The percentage for women increases significantly when including the processing sector.

Blue Transformation – intensifying and expanding sustainable aquaculture production

By 2030, aquatic food production is forecast to increase by a further 15 percent, mainly by intensifying and expanding sustainable aquaculture production. Such growth must preserve aquatic ecosystem health, prevent pollution, and protect biodiversity and social equality. Blue

Prepared by:

Matthias Halwart

FAO Fisheries and Aquaculture Division, Rome, Italy
based on the State of World Fisheries and Aquaculture 2022

Transformation aims to: (i) increase the development and adoption of sustainable aquaculture practices; (ii) integrate aquaculture into national, regional and global development strategies and food policies; (iii) expand and intensify aquaculture production to meet the growing demand for aquatic food and enhance inclusive livelihoods; and (iv) improve capacities at all levels to develop and adopt innovative technology and management practices for a more efficient and resilient aquaculture industry.

Implementing these solutions requires adequate capacity and skills, training, research and partnerships. Good governance, based on sound and enforceable legal and institutional frameworks, is fundamental to create an enabling environment to attract investment in aquaculture expansion. A balanced mix of finance and insurance services is needed at all scales to improve infrastructure and support technological innovations and mechanisms.

Emerging issues

The main emerging issues included COVID-19, adaptations to climate change and gender equality.

Since March 2020, the COVID-19 pandemic has been causing severe economic and societal disruptions, including to aquaculture. Often, aquaculture farmers

could not maintain planned production cycles, and pandemic restrictions affected both supply chains and mostly vulnerable and marginalized people, stressing the need for inclusive and shock-responsive social protection systems.

Increased warming affects aquaculture operations and calls for adaptation plans at national and local levels with an inclusive and participatory approach particularly considering small-scale producers.

It is recognized that despite their significant role in aquaculture, women are mostly engaged in the informal, lowest paid, least stable and least skilled segments of the workforce with limited access to resources, markets, decent employment, decision-making and leadership positions, calling for gender transformative approaches.

Outlook

The main increase to reach the expected 202 million tonnes of aquatic animals by 2030 is expected to come from aquaculture. The percentage of aquatic animal production for human consumption will further increase to reach 90 percent by 2030, leading to higher per capita consumption, with food supply increasing in all regions except Africa. The growth of aquaculture will contribute to the stability of trade in aquatic products, while an increase in prices of internationally traded aquatic products will be driven by improved incomes, population growth, strong demand, reduced supply and increased production cost pressure from inputs such as feed, energy and fish oil.

SEE

FAO. 2022. *The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation*. Rome, FAO.
<https://doi.org/10.4060/cc0461en>



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Group members showing off their seaweed ropes, Kibuyuni Seaweed Group, Kwale County, Kenya.



FAO at World Aquaculture Singapore 2022

The World Aquaculture Society (WAS) 2022 global event opened its doors in Singapore from 29 November to 2 December 2022. For the first time since the outbreak of the COVID-19 pandemic, WAS members met again physically for their international gathering. The grand opening featured a welcome by the WAS President and Conference Co-Chairs, a plenary presentation by FAO with the latest highlights from global aquaculture towards a Blue Transformation as well as a keynote by H.E. Grace Fu, Minister for Sustainability and the Environment of Singapore, outlining the ambition of Singapore in sustainably increasing its domestic production of aquatic food products.

The event brought together over 3 500 participants from 82 countries, predominantly from academia and the private sector, making WAS 2022 an excellent opportunity to engage and network with numerous aquaculture stakeholders. Over the course of the event there were many occasions to strengthen relationships and identify opportunities to consider aspects of sustainable aquaculture development around the world.

FAO also presented at another session, organized by the Feed the Future Innovation Lab at Mississippi State University, on joint work on rice farm diversification with catfish in the Nigerian states of Kebbi and Ebonyi along with the project partners, the University of Ibadan and the University of Georgia.

WAS 2022 featured 264 booths at the trade show, covering a wide range of products and services and providing an opportunity to hear from company representatives about the challenges in different production systems or the advantages of their products which ranged from tools and equipment for fish farming to probiotics and aquafeed ingredients produced from krill, insect meals or brewery by-products, and from Artemia shrimp harvested in saline

Written by:

Matthias Halwart

FAO Fisheries and Aquaculture Division, Rome, Italy

FAO's Matthias Halwart giving the plenary presentation on global aquaculture development to a full room at the opening of World Aquaculture 2022.

lakes to innovative aquaponic solutions to super-intensive shrimp farming in Singapore.

FAO's keynote presentations at global World Aquaculture events form one part of the good collaboration, and WAS is an active participant at FAO events such as the FAO/NACA Global Conference on Aquaculture Millennium +20 or the COFI Sub-Committee on Aquaculture. Aiming for greater engagement for mutual benefit, both FAO and WAS concur that a formal agreement will raise the value of this partnership and be a catalyst for continued collaboration. We look forward to strengthening the partnership for the benefit of all the people who depend on sustainable aquaculture.



The tradeshow during World Aquaculture 2022 featured many booths highlighting innovative technology, including these two of aquaponics in Singapore and production of black soldier flies for feed and fertilizer.



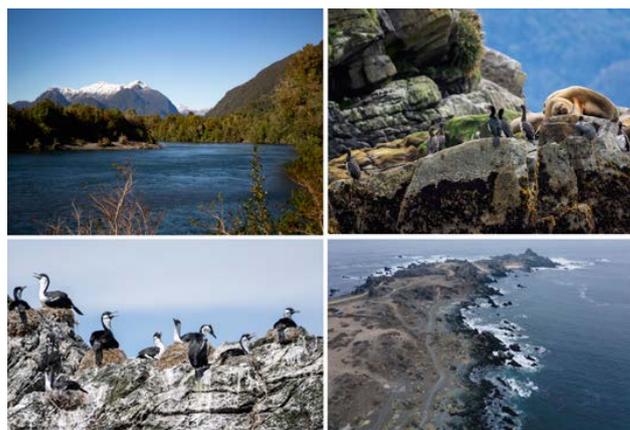
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New FAO project to strengthen marine and coastal governance in Chile in multi-resource use settings that include aquaculture

Background

Chile's marine and coastal ecosystems have globally significant biodiversity. This biodiversity provides a major contribution to the economic development of Chile, whose economy is highly dependent on the primary production sector and natural and environmental resources, including fisheries and aquaculture. However, the Chilean coastline has been subject to growing impacts from various anthropogenic activities. In several areas of the country these activities have contributed to the degradation of habitats and their associated biodiversity, including a sustained decline in the main fisheries stocks, which impact the livelihoods of coastal communities who live off these resources and who depend on healthy ecosystems. Although Chile has made significant efforts aimed at the conservation and sustainable use of marine and coastal biodiversity, these efforts have not been sufficient to remove the threats from overuse. So far, the marine and coastal environments are still not receiving the attention they deserve within national biodiversity management efforts.

More specifically, there are three main barriers to strengthening marine and coastal governance in Chile: (i) weaknesses of the institutional framework, including lack of interinstitutional coordination and the limitations



Examples of marine and coastal ecosystems and biodiversity in the selected areas of intervention.

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of public, private and civil society organizational capacities to manage coastal marine ecosystems; (ii) capacity constraints at the local level for planning and community involvement for developing operational mechanisms and implementing appropriate coastal marine ecosystems management and governance based on a shared view of the territory; and (iii) the lack of productive development incentives and funding mechanisms related to new goods, products, services and business models for the conservation and sustainable use of specific ecosystems and the prevailing coastal marine biodiversity.

Technical assistance

To overcome the above-mentioned barriers, FAO is providing technical assistance with a new project entitled “Strengthening management and governance for the conservation and sustainable use of globally significant biodiversity in coastal marine ecosystems in Chile”.

Written by:

José Aguilar-Manjarrez

Manuela Erazo Bobenrieth

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

Felipe Paredes Vargas

Ministry of the Environment, Santiago, Chile

To maintain biological integrity, diversity and ecosystem services for present and future generations and to move towards the sustainable and resilient use of marine and coastal ecosystems, the project aims to create an enabling environment. The objective is to develop and implement a governance system that mainstreams, coordinates and articulates public, private and civil society institutions for the conservation and sustainable use of marine and coastal ecosystems.

The project is executed by the Ministry of the Environment, jointly with the Ministry of National Assets, the Undersecretariat of Fisheries and Aquaculture (SUBPESCA), the Undersecretariat of the Armed Forces (S.S.F.F.A.A), the Undersecretariat for Regional Development (SUBDERE) and the National Fisheries and Aquaculture Service (SERNAPESCA), and is being implemented by FAO with funds from the Global Environment Facility. The project began in March 2022 and is expected to end in 2025. Two pilot sites have been selected, one in the coastal area of La Higuera and Freirina in the north and the other in the coastal area of Cisnes in the south.

The project is built on three main pillars:

- (i) a participatory model of governance and management at the local, regional and national levels, based on strong communication and collaboration among public, private and civil society actors, to ensure the sustainable use of coastal and marine ecosystems;
- (ii) a capacity building programme at the local, municipal, regional and national levels to ensure the responsible management of the ecosystems by empowering public, private, community and civil society organizations and by creating an enabling environment conducive to the conservation and sustainable use of marine and coastal ecosystems and biodiversity; and
- (iii) an ecosystems approach and a blue economy strategy¹ to strengthen active participation of local stakeholders and communities in the two pilot sites, and to foster the development of management plans as well as practices and technologies that incorporate the conservation and sustainable use of ecosystems and biodiversity.

Diversification of productive activities and innovation

To remove the third barrier (lack of incentives, investment and business models) and as part of the third pillar mentioned above, the project will promote the coordination of all relevant institutions at the local, municipal, regional and national levels focusing on strengthening financing mechanisms and strategies to best ensure sustainable ecosystem biodiversity and fishery resources. At the same time, the project will boost the capacities of local communities, organizations and entrepreneurs, particularly artisanal fisheries, small-scale aquaculture and tourism to promote the diversification of coastal economies through market strategies such as certification, value addition and direct marketing of artisanal fishery products. Removing this barrier will reduce market distortions, which negatively impact biodiversity and the economy of coastal communities.

In the northern pilot site, the project will support the implementation of three management practices and technologies, namely: (i) restocking brown seaweeds; (ii) supporting environmentally-sustainable and eco-friendly practices for recreational diving; and (iii) improving artisanal fisheries practices to reduce bycatch. The selection of these practices is related to threats to ecosystems and land use conflicts identified during the design of this project.

In the southern pilot site, the project will support the implementation of six management practices and technologies: (i) modifying crab traps; (ii) restocking mussels and seaweeds; (iii) enhancing small-scale aquaculture; (iv) developing pre- and post-landing management of fisheries resources; (v) introducing bird and mammal watching practices; and (vi) designing monitoring plans to evaluate the state of resources and to support decision-



Location of pilot sites. *Note:* In the northern pilot site, the marine portion of the project only corresponds to the territorial sea (12 miles), however, since there are islands in its interior, the distance is extended to an average of 14 miles in some locations.

1. Several definitions exist for Blue Economy: According to the World Bank, it is the “sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystem,” while the European Commission defines it as “all economic activities related to oceans, seas and coasts”.

making processes at the ecosystem, economic and social levels. The above-mentioned practices include activities of interest to the localities and which are technically feasible and appropriate for users.

The role of aquaculture development

Development of small-scale aquaculture represents an opportunity for productive diversification by artisanal fishers in the project pilot sites; it is a technology that is compatible with biodiversity conservation and a strategy to reduce the vulnerability of artisanal fisheries to climate change. However, to carry out these activities, fisheries organizations will need to have authorization from SUBPESCA, which requires a technical analysis, and fishers must be able to undertake the challenge (mostly cultural) to transform themselves from fishers to small-scale aquaculturists.



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Example of experimental small-scale aquaculture of brown seaweeds in Los Quincheles islands in Southern Chile (Aysén region), with a view to regenerate marine ecosystems and explore productive alternatives for coastal communities. Seaweed farms are important for their carbon fixation ability. Seaweeds are an important component of the aquatic food chain and, as primary producers, they support large numbers of animals and are used widely as edible food.

Non-public actors are also involved in the use of the coastal zone and the exploitation of coastal marine ecosystem resources in the selected areas of intervention, such as the salmon farming companies in the southern pilot site. Responsibly farmed salmon potentially provides food system solutions by contributing a nutrient-rich food source to diets that meet global dietary recommendations. However, social and environmental issues and other competing interests remain to be addressed, and thus it is important to: (i) improve public awareness of aquaculture by promoting a more open and broader dialogue that will increase transparency of the sector to identify solutions; (ii) put aquaculture in a wider perspective by comparing the benefits and impacts of all activities that exist in the

pilot sites; and (iii) ensure that salmon farming meets the guidelines and regulations set by government agencies – as well as the agreements established through a marine and coastal spatial planning process – to minimize conflicts among activities and maximize benefits, ensuring at the same time the resilience of these ecosystems.

Marine spatial planning

The multiple human pressures affecting the oceans have a real bearing on how effective governance should be undertaken. The governance of marine and coastal ecosystems in countries similar to Chile is primarily sectoral, with fisheries agencies regulating fisheries catches; environmental agencies dealing with pollution; and other specialized agencies regulating aquaculture, shipping, coastal development and mining activities. Strategies and policies for biodiversity and environmental management, climate change mitigation and adaptation and poverty reduction are also often developed and implemented by a diverse set of agencies. And herein lies the problem. Cumulative impacts cannot effectively be managed in isolation and, in order to develop a more holistic approach to ocean governance, these multiple stressors call for integrated management.

To strengthen marine and coastal governance in Chile, a marine spatial planning (MSP) process will be part of the project to bring together the multiple actors within the pilot sites, including government, conservationists, tourism operators, fisheries and aquaculture workers, port authorities, and urban and coastal planners among others. These actors will enable informed and coordinated decisions about how best to use marine and coastal resources sustainably so as to achieve environmental, social and economic objectives.

Marine spatial planning is one approach that can help countries (or smaller local areas) to integrate various management approaches undertaken by sectors into a comprehensive and cohesive plan with the ecosystem as its central framework. MSP provides a way to integrate human activities without compromising conservation values. Similar to integrated coastal zone management², MSP provides for operationalizing an ecosystem approach through a planning process involving all stakeholders at the local, regional and national levels.

MSP is operationally addressed using Geographic Information Systems.³ Through MSP, stakeholders can put forward their vision for an area; identify where human activities currently occur and where they should take place in the future; and determine actual or potential conflicts and/or synergies among different marine and coastal-related uses, as well as human activities and desired conservation outcomes. The resulting spatial plan can provide for sustainable use while also conserving specific

2. Marine spatial planning (MSP) and integrated coastal zone management (ICZM) both involve a strategic approach to planning within the marine environment in terms of uses and activities; the main difference between the two are the scales to which they can be applied. Typically ICZM is applied to marine zones less than 2 kilometres from the coastline; conversely, MSP can be applied to much wider areas such as coastal watersheds or exclusive economic zones. (United Nations Environment Programme, 2018).

3. Geographic Information System (GIS) is a computer system for capturing, storing, checking and displaying data related to positions on the Earth's surface. By relating seemingly unrelated data, GIS can help individuals and organizations better understand spatial patterns and relationships.



Workshops from June 2022 at the pilot sites, where the project was officially launched and where local communities met with international, national and local authorities to discuss future challenges for the conservation and sustainable plus resilient use of marine and coastal ecosystems to prepare for marine spatial planning.

resources and/or habitats through marine protected areas, “other effective area-based conservation measures” (OECMs), as well as other appropriate measures in a manner that avoids potential conflicts.

Important issues that need consideration to strengthen marine and coastal governance in Chile include conflicting interests of public and non-public actors. These aspects involve a consideration of the multi-level and multi-scale architecture of governance, the differential capacity (political, technical and financial) of the different actors, the adaptiveness and resilience (e.g. climate change) of diverse planning and management arrangements, the effectiveness of transparency and accountability among

different actors, and the structure and process of the allocation of space, access of benefits, and assessments of harms to the ecosystems. It is also important to identify potential opportunities and synergies between sustainable development of coastal communities, aquaculture, and marine and coastal conservation.

It is expected that the outputs of this project will help maintain the integrity and diversity of marine and coastal ecosystems services for present and future generations. Ultimately, the lessons learned would be replicated at a much larger scale in Chile, and hopefully provide guidance to neighboring and more distant countries.

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REMAPE: A new Mesoamerican small-scale aquaculture network



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Family-owned tilapia farm in El Guatuso, Costa Rica.

The Mesoamerican region comprises Mexico and the Central American countries, namely Belize, Costa Rica, Guatemala, El Salvador, Honduras, Nicaragua and Panama. Aquaculture in this region, as in the rest of the Americas, was introduced in the late 1960s through a variety of government programmes to diversify agricultural production and provide alternative sources of employment in rural areas.

The development of mass production techniques for marine shrimp and the expansion of tilapia culture throughout the region during the 1980s and 1990s stimulated a rapid expansion of industrial aquaculture for export purposes, thus reaching almost 420 000 tonnes in 2020 (FAO-FishStat, 2021).

However, such transition to industrial scale and to international markets did not stop small-scale aquaculture in the region from growing. Small-scale farmers have been the main source of fish for domestic markets, as well as an important pillar of food security, along with small-scale fisheries, particularly in rural areas. Moreover, in many instances, small-scale aquaculture farmers are integrated into export-oriented value chains, thus also contributing to generate hard currency for their countries. Although the

Written by:

Alejandro Flores-Nava

FAO Subregional Office for Mesoamerica, Panama City, Panama

weakness of national aquaculture registry systems makes it difficult to have a precise figure, it is estimated that there are about 18 000 small-scale aquaculture farmers in the region (UN News-Mexico, 2022). Nonetheless, their lack of financial and technological resources have limited them to further develop, become more resilient and be economically sustainable, particularly in times of external shocks, such as the COVID-19 pandemic, economic recessions and natural disasters (FAO-CEPAL, 2015).

In 2021, the Mesoamerican Committee for the Celebration of the International Year of Artisanal Fisheries and Aquaculture 2022 (IYAFA 2022) was established. The committee is composed of representatives of Mexico's National Commission on Aquaculture and Fisheries and Central American countries, these latter represented by the Organization of the Fisheries and Aquaculture Sector of the Central American Isthmus (OSPESCA), regional small-scale fisherfolk organizations and national small-scale aquaculture organizations of Mesoamerican countries, with FAO serving as its Secretariat.

One of the milestones of the workplan of the committee was fostering the creation of a Mesoamerican mechanism, the first of its kind, to group small-scale aquaculture farmers to help them improve their connectivity, strengthen their associativity and organization, and consequently increase their competitiveness and resilience.

The lead was taken by the Tilapia Network Mexico and, after identifying, contacting and consulting with other national aquaculture associations, common ground and interests were identified, and membership criteria, working principles and basic structure were agreed upon. On



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Family-owned farm in northern Paraguay.

29 September 2022, the Mesoamerican Network of Small-scale Aquaculture Framers (or REMAPE for its acronym in Spanish) was officially created. The founding members of the network are national small-scale aquaculture associations of Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Mexico and Nicaragua.

Mission, objectives and structure

The mission of REMAPE is to “strengthen the cooperation and synergies among Mesoamerican small-scale aquaculturists, their value chains, governments and academia to foster their economic development in an inclusive and sustainable manner”. The founder associations of the new network have established a series of criteria to become a member. These relate to the actual scale of production and the overall farm income, thus limiting membership to farmers who are small in scale and low in output. The farmers in the network are those who find more benefit in sharing and cooperating than in competing for market share. In practical terms, the objectives of the network include the following:

- information and experiences exchange among farmers and other links of their value chain;
- identification of regional market opportunities for economies of scale;
- strengthening technological and managerial capabilities;
- fostering innovation and technology adoption and improvement;
- promotion and execution of solidarity actions among members in cases of natural disasters or other emergencies; and
- joint development of policy proposals to improve the governance and overall social and economic conditions of small-scale aquaculture dependent families.

The agreed structure of REMAPE is simple: It has a coordinator and a deputy coordinator, both elected by consensus by the members for a period of two years. The first elected coordinator is the representative of Mexico, who led the forming process, and the deputy coordinator is the representative of Guatemala.

Rollout and future

In its two months of existence, REMAPE has already realized a number of joint actions, including jointly displaying the products of its members in national and international seafood shows. Members already participate in seminars organized by the Tilapia Network Mexico and are in the process of preparing a strengths, weaknesses, opportunities and threats (SWOT) analysis of REMAPE’s member associations to identify gaps in terms of technology, managerial skills, market position and organization as a basis for a better informed workplan preparation. Members have requested that FAO remain as a technical partner.

SEE ALSO

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Arapaima are important inland fisheries species, and declining catches and conservation considerations have led to high interest in their aquaculture.

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Unlocking the potential of aquaculture for food security and climate resilience in the Caribbean

The Resilient Caribbean Initiative implemented by the Government of Mexico, the Caribbean Community (CARICOM) and FAO is supporting the development of the aquaculture sector to benefit vulnerable populations, promote food security and rural employment, reduce the dependency on food imports (which account for 60 to 80 percent of the food consumed) and supplement the production of capture fisheries while making efficient use of the available aquatic resources, limited arable land and worsening water scarcity problems.

The subproject “Resilient Aquaculture for Food Security and Well-being in the Caribbean” is specifically supporting four Caribbean countries to develop their aquaculture industries and improve the resilience of their aquatic food production sectors. Stories of innovation and resilience building can be found throughout the project, highlighting the potential for advancing thriving aquaculture industries in this region of the world.

Aquaculture driving growth of Grenada’s best-known superfood: sea moss

The tri-island state of Grenada, Carriacou and Petite Martinique is known for its favourable conditions for both freshwater and marine aquaculture. Boasting a continental shelf ten times larger than the land area, unpolluted waters, tropical climate and many large, protected bays, Grenada is an ideal location for cultivating the region’s best-known superfood: sea moss.

Sea moss aquaculture has been steadily growing, largely because of the ease and simplicity of its cultivation, but also because of its health benefits and increasing export value. In optimum conditions, farmers can easily grow sea moss from a cutting, attaching it to a string and securely anchoring to the seabed. The farmers need a calm bay area to avoid the sea moss being beaten by wave action while allowing adequate flushing or movement of the water through the plot.

Written by:

Firhaana Bulbulia

Risha Alleyne

Krisma Moore

Steve George

FAO Subregional Office for the Caribbean, Bridgetown, Barbados



Sea moss farmer holding harvested sea moss, Grenada.

Because of the many ways seaweed can be used and the high nutritional value, the price per kilogram at export has been increasing, making it a profitable venture for aquaculture farmers. Additionally, being a rich source of minerals such as zinc, magnesium and iron, its popularity is steadily rising.

Sea moss farming has also been linked to the mitigation of climate change impacts. In Grenada, sea moss aquaculture along the coast provides a buffer for high waves and sea swells and provides an added layer of protection for the shoreline and surrounding communities. However, sea moss farming requires shallow areas, which are being threatened by the intensifying impacts of climate change, particularly in Grenada.

The Resilient Caribbean Initiative has been supporting the development of the sea moss industry, enabling farmers to expand their operations as a way to sustain their livelihoods and increase the potential positive impacts on the environment.

Sea moss farmer, Jean Maturine shares:

“One of the biggest issues we face is the lack of cover for drying the sea moss. In the rainy season, if farmers do not have adequate shelter and storage, the sea moss would spoil, diminishing profits and creating wastage”.



Sea moss farmer storing over 70 bags of harvested sea moss. The provision of solar dryers will ensure that sea moss stored in these conditions will not spoil from exposure to rain.

The project is helping to tackle this issue by providing solar dryers to process the sea moss using renewable energy (sun and wind). It is also building the capacity of farmers to develop their businesses, manage and access financing, and expand product lines to include value-added products such as gels, shampoos, smoothies and soaps.

The power of hands – a story of determination in Dominica

Martina’s determination to become an aquaculture farmer led to a community of friends and family coming together to dig a pond by hand, a process that took close to one month but that has boosted the aquaculture industry in the small Kalinago village of Salybia, Dominica.

The Kalinago are an indigenous minority in Dominica, residing predominantly on the eastern coast of the island. Farming is a critical part of their culture and traditions, and they are well known for their extensive use and expertise in herb and plant medicine. Their diet is deeply rooted in the produce of the earth, and fish is an important protein source as has been recorded throughout their history.

This tradition has always been a part of Martina’s identity, drawing her to aquaculture as a way to feed her community, gain employment and provide financially for her family. Being introduced to aquaculture by another farmer, Martina set her sights on managing her own operations.

“I saw a demand for aquaculture products in my community, as many people prefer fish. I was determined but I lacked the financial resources to get the materials needed to build my own system; this is what motivated me to dig a pond by hand. I didn’t do it alone, friends helped me, and the process took us three weeks.”

Digging the pond was the first hurdle, however. Martina soon confronted a number of other challenges, including facing the harsh impacts of climate change and finding ways for the system to run efficiently.



Martina holds a Mozambique tilapia produced at her farm.

“Since digging the pond, Dominica was devastated by Hurricane Maria; this caused structural damages to the pond, which had to be fixed. I have also faced challenges with the water intake system, as it did not have the capacity to provide adequate water to the pond along with the unavailability of seedlings (postlarvae prawns) and feed, which all leads to my inability to meet local demand.”

To improve the resilience of the aquaculture sector, it is critical that the experiences of farmers like Martina are highlighted. Her perseverance and drive to advance this sector in Dominica, along with the support provided through projects such as the Mexico-CARICOM-FAO Resilient Caribbean Initiative, will ensure a thriving aquaculture industry and one where the leadership of indigenous women in the sector is sustained.

The project “Resilient Aquaculture for Food Security and Well-being in the Caribbean” is supporting aquaculture farmers like Martina to increase their production by providing funding and technical assistance to construct or expand their operations. This includes providing farmers with equipment and inputs as well as training them in areas such as financial literacy (business plan development) and good aquaculture practices.



Martina harvesting (left) and feeding (right) fish in her earthen pond in Dominica.

FAO expert workshop on aquaculture co-management



Participants of the FAO expert workshop on aquaculture co-management. Kigali, Rwanda, 8 June 2022.

In fisheries, co-management refers to a mode of governance through which resource users and government share responsibility and authority for the management of fishery resources, with support and assistance as needed from other stakeholders, external agents, and academic and research institutions. While the application of the concept of co-management started to be practised in the capture fisheries sector a few decades ago, in aquaculture the concept is new, including its application to unleash its potential for the development of the sector.

In 2020, FAO, with the support of the Ministry of Oceans and Fisheries of the Republic of Korea and the Korea Maritime Institute, launched two projects that focused on the design and implementation of contextualized fisheries co-management systems at national and local levels.¹ Co-management is an instrument that could be effectively used to reach a more sustainable approach to aquatic resources. It is a mechanism for power sharing, institution building, trust and social capital enhancing, problem solving, knowledge-sharing and social learning, as well as for encouraging collaborative opportunities and collective action. Recognizing this, FAO now foresees to bring the models of co management to aquaculture

systems. Implementation of the ecosystem approach to aquaculture requires management models that provide guidance to governments and the private sector alike. In addition, collaborative management models are needed for the implementation of the upcoming FAO Guidelines for Sustainable Aquaculture (GSA).



Ms Chantal Ingabire, Director-General of Planning in the Ministry of Agriculture and Animal Resources of Rwanda, officially opened the workshop.

Written by:

Turan Rahimzadeh
Elisabetta Martone

FAO Fisheries and Aquaculture Division, Rome, Italy

1. The projects were "Fisheries Co-Management Capacity Development for Blue Communities: Sustainable Fisheries and Diverse Livelihoods" (GCP/GLO/080/ROK) funded by the Ministry of Oceans and Fisheries of the Republic of Korea; and "Fisheries Co-Management Capacity Development Program" (GCP/GLO/046/ROK) funded by the Korea Maritime Institute.



Mr Orlando Sosa, Officer-in-Charge of the FAO Representation in Rwanda and workshop participants during Day 1.

An initiative to promote co-management was the FAO Expert Workshop on Aquaculture Co management that was held in a hybrid format from 8 to 10 June 2022 in Kigali, Rwanda. Eighteen experts from 13 countries attended the meeting: Cameroon, Canada, China, Kenya, Malawi, the Netherlands, Nigeria, Republic of Korea, Rwanda, Thailand, the United Kingdom of Great Britain and Northern Ireland, the United States of America and Viet Nam.

The workshop objectives included exploring the new concept of aquaculture co-management, discussing the main steps to guide successful implementation of a co-management system in aquaculture, and reflecting on the future role of aquaculture co-management in the global development of the sector.

Mr Orlando Sosa, Officer-in-Charge of the FAO Representation in Rwanda, welcomed the participants and highlighted FAO's commitment to developing the aquaculture sector, remarking that the United Nations General Assembly declared 2022 the International Year of Artisanal Fisheries and Aquaculture.

The workshop was opened by Ms Chantal Ingabire, the Director-General of Planning in the Rwandan Ministry of Agriculture and Animal Resources, who highlighted the potential for aquaculture co-management in Rwanda by providing incentives for value chain investments aimed at increasing employment and incomes.

The participants were first introduced to a draft rationale, the definition, principles, models and approaches for monitoring and evaluating aquaculture co-management.

Participants were then invited to provide advice on these elements to establish a shared understanding of the concept and define a pathway towards its further development.

The outcomes of the workshop, which will be available in a forthcoming report, will guide the implementation of the three-year project "Development of the Aquaculture Co-management System for Sustainable Aquaculture" funded by the Korea Maritime Institute. The project will work to produce knowledge products on aquaculture co-management and to develop a framework for its application as an aquaculture governance instrument, with the aim of enabling aquaculture to contribute effectively to the achievement of the Sustainable Development Goals in the long term and move towards the Blue Transformation. Knowledge products will include a guidebook and an e-learning course for establishing aquaculture co-management systems, and case studies looking across the breadth of aquaculture production systems.

SEE ALSO

Smart Fisheries Co-management
www.fao.org/in-action/kofap/projects/sfc/en/

FAO Expert Workshop on Aquaculture Co-management | KOFAP | Food and Agriculture Organization of the United Nations;
www.fao.org/in-action/kofap/news-events/news-details/en/c/1513270/

Experts meet in Kigali for an FAO workshop on Aquaculture Co-management | FAO in Rwanda | Food and Agriculture Organization of the United Nations
www.fao.org/rwanda/news/detail-events/en/c/1539073/

Exchange visit in Côte d'Ivoire demonstrates possibilities to improve productivity of tilapia farming

FISH4ACP facilitates experience sharing on recirculation aquaculture and biofloc technology system



Cubitainers (nursery) for tilapia fingerlings.

An exchange visit on recirculation aquaculture systems (RAS) and biofloc technology (BFT) in Côte d'Ivoire demonstrated the potential to sustainably intensify tilapia production. The visit was organized by FISH4ACP, a global fish value chain development initiative promoting sustainable growth of the tilapia sector in Côte d'Ivoire.

More than twenty fish farmers from all over the country, as well as technicians from the Ministry of Animal and Fisheries Resources, took part in the two-day exchange on 24–25 August 2022. The visit aimed at improving participants' knowledge and technical capacities in both systems and covered two farms near the capital of Abidjan.

Written by:

Founignué Traoré Epse Djiré

FAO Representation to Côte d'Ivoire

Maarten Roest

Arthur Rigaud

FAO Fisheries and Aquaculture Division, Rome, Italy

Participants raised issues regarding the installation and production costs of the systems, the use of local material to save costs, the improvement of existing production

Recirculation aquaculture systems

A recirculation aquaculture systems (RAS) is an aquaculture system that needs little space and water and allows to grow 100 kg/m³ of fish biomass. Water is recirculated and settled materials are eliminated from the production unit at a high rate to keep the water clean. The system never releases the water. Instead, it treats and returns it to the production unit. The RAS involves an external biofilter for nitrifying bacteria and filters for removal of solids from the water. Some systems also have UV lamps for water sterilization (Ray, 2017).

Biofloc technology system

Developed for intensive aquaculture with low investment and maintenance cost, the biofloc technology (BFT) system allows feed to be recycled. This technique is based on the generation of a nitrogen cycle to maintain a carbon-nitrogen ratio of 10:1 or 15:1, which stimulates heterotrophic microbial growth and in turn assimilates nitrogenous waste that can be used as feed. Zero or minimal water exchange is used to conserve water, achieve maximal biosecurity and minimize the external environmental effects of fish culture. To reduce excessive levels of organic matter and oxygen depletion, artificial aeration is needed (Avnimelech, 2012).

systems, as well as training and production services offered.

FISH4ACP is an initiative of the Organisation of African, Caribbean and Pacific States (OACPS) aimed at making fisheries and aquaculture value chains in Africa, the Caribbean and the Pacific more sustainable. It is being implemented by FAO with funding from the European Union and the German Federal Ministry for Economic Cooperation and Development (BMZ).

In Côte d'Ivoire, FISH4ACP is working to improve the productivity and sustainability of the tilapia value chain. The initiative was launched in 2020 and will continue until 2025. The exchange visit marked the start of the implementation of an upgrading strategy of the tilapia value chain in Côte d'Ivoire that FISH4ACP has helped to

develop with key stakeholders of the sector. The strategy focuses on sustainable intensification of tilapia production and expansion of existing farms through the promotion of more efficient production systems adapted to local conditions.

RAS and BFT are closed aquaculture systems that allow farmers to produce quality fish with multiple social and environmental advantages. The equipment needed is flexible in size and takes up little space, while the technologies allow for improved breeding productivity and reduce the impact on the environment.

Madame Fofana's fish farm

Madame Fofana has a fish farm in the courtyard of her family home, where she produces tilapia for the fish

restaurant that she runs. She holds a master's degree in business administration and management and started tilapia farming in February 2021. She is a self-taught fish farmer who started out as a simple aquarium aficionado.

The farm is built on less than 100 m² and sits close to the restaurant, which takes the entire output of the farm. Ms Fofana produces her own fingerlings, as she has had many problems with fingerling supplies, particularly due to disease. The broodstock comes from other fish farms or nursery stations, whereas the extruded feed is imported.

The estimated production capacity of Madame Fofana's farm is 8 tonnes per year with a stocking density of around 45 fish/m³. She is keen to reach higher densities, and understands that she needs to improve her knowledge of production techniques to achieve that goal.

Ms Fofana said that she achieves substantial added value. Each fish sells for about XOF 7 000, or USD 10, in her restaurant at a cost of between 2 000 and XOF 3 000 for the fresh product.

The facilities at Ms Fofana's farm are built with recycled local material. For example, she has transformed an out-of-use freezer into a fish tank. Plastic bins, cubitainers, garbage buckets or even barrels serve as ponds or filtration systems. Plastic bottle caps are used to bind bacteria during biological filtration. Empty onion sacks, worn mosquito netting or broken clay canaries provide physical filtration.



Participants during the round table for the presentation.



Cook preparing tilapia in maquis.

Rina Fish

Thony Agré is a young fish farmer and a passionate promoter of the BFT. With a degree in visual communications, he started tilapia farming using the BFT in 2017, calling his business Rina Fish.

Since then, Thony has expanded his business and is now also offering training on how to use the system while also helping other producers to install facilities. One of his achievements is the "fry-food-equipment", a turnkey package which he himself developed, for people who are interested in the biofloc system and want to test it.

Thony is constantly working to improve production and the services he offers. He has serious ambitions for the future. Using a system that combines BFT during the nursery stage and floating cages for on-growing in the lagoon close to his farm, he plans to dramatically increase production. From 8 tonnes in 2020 and 2021, he eventually hopes to reach 150 tonnes per year.

Discovery

The exchange visit turned out to be a real discovery for the participants. Production on most fish farms in Côte d'Ivoire averages between 1 and 5 tonnes per year in ponds that can reach up to 500 m² and which use large volumes of water. Ms Fofana's example of producing 8 tonnes per year on just 100 m² with recirculated water has shown fish farmers that it is possible to improve their productivity. The turnkey package proposed by Mr Thony Agré is also a good example of an initiative to support people to begin using the BFT system to produce tilapia.

At the end of the exchange visit, participants agreed on the need to set up a discussion forum and a framework for exchanging experiences so they can learn from each other. They also expressed their interest in training sessions on how to install and operate the RAS and BFT system.

Other good practices to intensify production were also discussed during the exchange. These included the need to regularly monitor breeding parameters – temperature, pH and dissolved oxygen level, for instance – and the use of quality food to maximize growth of fish in extensive systems.



Guided tour at Ms Fofana's farm.

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Participants during the guided tour at Rina Fish.



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MORE INFORMATION

FISH4ACP in Côte d'Ivoire:

www.fao.org/in-action/fish-4-acp/where-we-work/africa/cote-divoire/en

International Year of Artisanal Fisheries and Aquaculture (IYFA 2022) story on the exchange visit:

www.fao.org/artisanal-fisheries-aquaculture-2022/events/events-detail/en/c/1601360

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FAN

SVC4MED – Improving fisheries and aquaculture value chains in the Mediterranean: A focus on farmed rainbow trout

Aquaculture plays an important role in global food security, and its contribution is expected to increase to more than 100 million tonnes by 2030.¹ It has been one of the fastest growing food production sectors in the past decades; however, the rapid development of aquaculture has, in some instances, resulted in negative impacts on the environment and society. To realize the potential of aquaculture and maximize its contribution to the Sustainable Development Goals (SDGs), it is vital to identify and address existing sustainability issues and to establish sound governance for future development.

Since aquaculture is embedded in a broader food system of interconnected activities, effective transformative action requires a holistic approach. The value chain approach has become a prominent framework for analysis and development in the food sector. It is designed to identify and understand the core factors and interrelated constraints associated with all main components of the system in a holistic fashion and enable the identification of upgrading opportunities. The value chain approach to fisheries and aquaculture development is being applied in various contexts by FAO, including in the Small Island Developing States around the world and in coastal countries in the Mediterranean region.

SVC4MED² is one of the value chain development projects implemented by FAO's Fisheries and Aquaculture Division.³ With a focus on five Mediterranean countries, the project aims to develop upgrading strategies to increase the competitiveness and the economic, social and environmental sustainability of the value chains of farmed rainbow trout in Albania, Italy and Lebanon and shrimp from capture fisheries in Italy, Tunisia and Türkiye. For this purpose, the project will perform a value chain analysis following a methodology based on following the FAO guiding principles on sustainable food value chain



Trout larvae at an Italian hatchery.

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development⁴ and value chain analysis for development⁵ of the European Commission.

The methodology includes mapping and assessing the performance of the selected value chains in terms of economic, social and environmental sustainability aspects and resilience to shocks on the basis of which to develop the visions and strategies for upgrading the functioning and performance of the selected value chains. In addition, the project aims to facilitate regional cooperation on value chains, promoting capacity building among small-scale fishers, aquafarmers and producer organizations. Ultimately, the project contributes to SDG 14 on “Life below water”, SDG 5 on “Gender equality” and SDG 8 on “Decent Work and Economic Growth”, as well as to FAO's four betters – better production, better nutrition, a better environment and a better Life.

1. FAO. 2022. *The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation*. Rome, FAO. <https://doi.org/10.4060/cc0461en>
2. Acronym for “Improving Fisheries and Aquaculture Value Chains in the Mediterranean within the Blue Growth Initiative”. SVC4MED is funded by the Directorate-General of Fisheries and Aquaculture, Government of Italy, and implemented by FAO between 2021 and 2024. www.fao.org/in-action/sustainable-fisheries-aquaculture-mediterranean/en
3. Other projects include **FISH4ACP** and **SVC4SIDS**.
4. FAO. 2014. *Developing sustainable food value chains – Guiding principles*. Rome. <https://www.fao.org/policy-support/tools-and-publications/in-resources-details/en/c/422953>
5. Fabre, P., Dabat, M.-H. & Orlandoni, O. 2021. Methodological brief for agri-based value chain analysis. Frame and Tools – Key Features. Version 2 – February 2021. <https://europa.eu/capacity4dev/file/122612/download?token=U42DpPQjn>

Written by:

Dimitar Taskov

FAO Fisheries and Aquaculture Division, Rome, Italy

Edmond Hala

Agricultural University of Tirana, Tirana, Albania

Maria Cozzolino

NISEA Società Cooperativa, Salerno, Italy; Università degli Studi di Messina, Messina, Italy

Rainbow trout is one of the first species that have been produced in closed-cycle aquaculture, with its history dating back to the nineteenth century. The closed-cycle system has a well-established production technology, which is relatively simple, making it possible for a variety of producers, including small-scale artisanal fishers, to engage in this activity. A relative to salmon, rainbow trout is versatile in terms of processing, and a range of products can be derived from the fish, including low value-added affordable options, such as whole portion-size fish to high-value niche products such as smoked fillets and fish roe.

The environmental requirements of rainbow trout make it a suitable option for inland aquaculture development in different geographical territories, including most of Europe and to some extent in the east Mediterranean. The remaining section of this article examines preliminary findings from the three farmed rainbow trout value chains for Albania, Italy and Lebanon, as the data collection phase of the project is nearing completion.

Rainbow trout production in SVC4MED project countries

Country	Total inland aquaculture production (tonnes)	Rainbow trout production	Number of rainbow trout farms
Albania	1 812	1 612	16
Italy	36 518	33 230	366
Lebanon	4 342	4 143	364

Data sources: (i) Production in Albania and Italy (2020): FAO. 2022. Fishery and Aquaculture Statistics. www.fao.org/fishery/statistics/software/fishstatj/en; and (ii) all data on Lebanon (2019) and number of farms for Italy and Albania (2022) are based on preliminary project results. SVC4MED refers to Improving Fisheries and Aquaculture Value Chains in the Mediterranean within the Blue Growth Initiative.

Albania

Rainbow trout aquaculture in Albania constitutes about 1 600 tonnes annually, produced by 16 farms using raceways and cages in freshwater bodies of water. Around a third of this quantity is produced by small-scale family-operated enterprises with an annual harvest ranging from 2 to 200 tonnes, while the remaining quantity comes from one large-scale foreign-owned company. Some of the family-



A trout aquaculture farm in Albania.



A fish farm in Anjar Bekaa Valley producing rainbow trout for sale to restaurants and shops.

operated farms diversify trout production for the market with agritourism as a source of additional income. Albanian rainbow trout is primarily destined for export as either chilled or frozen whole portion-size fish or fillets to the European Union market. Domestic consumption of trout is limited, as most Albanian consumers prefer marine fish.

Preliminary assessment indicates several areas for value chain upgrading. At the farm level, there is scope for improving management practices through technical and administrative capacity building to increase productivity and adapt to the risks posed by climate change. The establishment of a producer organization or cooperative to coordinate collective action, including input supply and marketing of products, presents a further opportunity for development.

The industry relies entirely on imported aquafeeds; therefore, to increase the contribution of the value chain to the national economy, the potential for domestic feed production needs to be explored. Likewise, the development of higher value-added products, such as smoked fillets, for export and domestic markets and the inclusion of trout in restaurant menus in light of the growing tourism sector in inland destinations close to trout production areas could present viable opportunities for increasing the economic impact of this value chain.

At a broader level, national governance can be upgraded through the development of zonation for inland aquaculture and aligning aquaculture legislation with European Union standards. The rising competition for water from other water users (energy, urban development, irrigation) necessitates the development of policies that clearly define the rights over water for different stakeholder groups.

Italy

In 2020, Italy produced more than 33 000 tonnes of rainbow trout, which represented almost the entire output of the domestic freshwater aquaculture sector. More than 60 percent of the national trout production in terms of volume and 70 percent of the value is generated in the three northeast regions of Veneto, Trentino Alto Adige and Friuli-Venezia Giulia, collectively known as Triveneto. The fish are grown in raceways and earthen ponds, mostly within small-scale, family-run enterprises. The bulk of

Italian trout (70–80 percent) is destined for domestic consumption, distributed mainly through multiple retail chains, with the rest being exported mainly to other European countries, particularly Austria, Germany and Switzerland as fresh whole gutted fish and fresh fillets. Some of the fish are processed into value-added products.

Per capita trout consumption in Italy is not high because marine fish are generally preferred in Italian markets. The price of portion-size trout is lower than popular marine-grown fish such as seabass and seabream of equivalent size. This represents an opportunity for market development through promotion of trout products and new product development.

Other challenges to the industry include climate change and extreme weather events, which have been especially acute in 2022 with a continuous drought and high summer temperatures, leading to high fish mortality levels and economic losses. The costs of inputs are rising, putting additional pressure on the profitability of the industry. Therefore, better management practices and adaptation strategies need to be implemented to improve the resilience of the industry and mitigate against rising costs of production and increasing risks from climate change.

Since production is dispersed among many small-scale farms, a means for aggregating the product, such as through cooperatives, consortia and mainly producers' organizations, is a possible way for strengthening the bargaining position of farmers in the value chain, improving dialogue, and promoting interaction with suppliers of raw materials and large buyers such as multiple retail chains. Joint action is also needed to improve the visibility of trout producers in end markets.

The lack of a skilled labour force and the low attractiveness of aquaculture jobs are pervasive problems in all the countries investigated. Opportunities for addressing these challenges should include strengthening the dialogue with the local school system to ensure that there will be vocational training for prospective employees, which will also help increase the visibility and reputation of the trout farming sector. For successful implementation of some of the upgrading strategies, support should be provided to

benefit from the public financing measures guaranteed by the structural funds of the European Fund for Maritime Affairs, Fisheries and Aquaculture and the Italian Strategic Plan for Aquaculture 2021–2027.

Lebanon

Aquaculture has been practised in Lebanon since the 1930s, and currently more than 90 percent of the production in the country consists of rainbow trout. There are 364 farms, most of which are located in the Bekaa area along the Assi River. The river provides suitable conditions for rainbow trout farming, with the water temperature ranging between 15 and 16.2 °C. In 2019, more than 4 000 tonnes of rainbow trout were produced, representing an important contributor to the local economy and food security. The industry is composed entirely of small-scale family operated farms. The main harvest size of trout is 250–350 g. Fish in this category are sold live to restaurants or directly at the farm. Only a small amount reaches the final consumer through supermarkets. However, fillets of larger size trout (0.5–1.0 kg) with pink flesh are gaining popularity in the context of rising prices of imported salmon products with similar characteristics.

The main opportunity to strengthen the value chain is to establish a regulatory framework for the trout aquaculture sector, which at present is not well developed and farm operations are not regulated by the government. The unregulated development of the sector has resulted in the establishment of facilities with suboptimal conditions for aquaculture. In the context of the challenging economic situation in Lebanon, the rising cost of living and the reduced ability to purchase imported products, upgrading strategies need to address the need for transformation of the trout value chain into a well-functioning and sustainable contributor to domestic food security. In addition to establishing and enforcing a regulatory system, there is a need to provide capacity building to local farmers in better management practices. Opportunities for increasing the popularity of trout across the country exist, and the development of value-added trout products presents a route for generating additional value downstream in the value chain.



Rainbow trout (*Oncorhynchus mykiss*) is one of the top aquaculture species globally, and especially important in several Mediterranean countries.

FAO Special Day at Aquaculture Europe 2022



Mariana Toussaint presents an overview of the global trends and markets of aquaculture products.

On the occasion of the European Aquaculture Society's annual meeting, held this year in Rimini, Italy, FAO was invited by the organizers to convene a FAO Special Day under the theme of international processes and their implications to the European aquaculture industry.

The access to applied production innovations, appropriate governance and support policies, and economic and market forces play an important role in the current and future development of any specific food industry at the national, regional and global levels. FAO, with its key

Written by:

Austin Stankus

FAO Fisheries and Aquaculture Division, Rome, Italy

mandate focused on food production, provides the global discussion and knowledge-sharing platform along with tools and guidelines that will enable countries to support their aquatic food production industries in producing and distributing their products while ensuring that environmental, social and economic sustainability issues are fully met. The FAO Special Day focused on a number of relevant international processes and discussed their implications on the development of the European aquaculture sector through four interconnected sessions.

SESSION 1

The Global Processes on Sustainable Aquaculture: What Does It Mean to European Stakeholders?

Was moderated by Austin Stankus, with the objective to present the outcomes of the Global Conference on Aquaculture Millennium +20, including the Shanghai Declaration and the regional review of European aquaculture, while also referencing the forthcoming Guidelines for Sustainable Aquaculture and highlighting their use to enhance institutional and intergovernmental cooperation for the advancement of European aquaculture and its contribution to the United Nations Sustainable Development Goals.

Opening remarks were given by Lorella de la Cruz Iglesias of the Directorate-General for Maritime Affairs and Fisheries of the European Commission. FAO presentations were made by Graham Mair and Austin Stankus, who presented an overview of FAO's global and regional processes and the 2020 regional review of aquaculture in Europe,

respectively. Following the presentations, a panel session consisted of Laszlo Varadi (Network of Aquaculture Centres in Central and Eastern Europe), Javier Ojeda (Federation of European Aquaculture Producers), Chiara Petrioli (La Sapienza University, Rome, Italy), David Basset (European Aquaculture Technology and Innovation Platform), Yolanda Morales (AQUIPlus Cluster), Petter Johannessen (IFFO Marine Ingredients Organization), Gyula Kovács (Research Institute for Fisheries, Aquaculture and Irrigation, Szarvas, Hungary) and Jon Arne Grottum (Norwegian Seafood Federation). Discussions with the panel focused on the importance of cooperation and engagement among all stakeholders, specifically producers, policymakers, academics and value chain actors, highlighting good examples of networking and joint initiatives.

SESSION 2

Genetic Resources in Aquaculture: Perspectives on Enhancing Their Management

Was moderated by Graham Mair and Austin Stankus, with the objective to present an overview of key issues in the current management of genetic resources in European aquaculture, and to outline and discuss the role that FAO developed resources, including a Global Plan of Action and AquaGRIS, a new information system for aquaculture species, can play in enhancing this management.

This session had four speakers: Graham Mair, FAO Senior Aquaculture Officer; Daniela Lucente, FAO consultant; Marc Vanderputte, research scientist at the National Research Institute for Agriculture, Food and the Environment, France; and Mohammad Pourkazemi, affiliated member of the Caspian Sea Water Basin Research Institute, at Guilan University. During the session, FAO presented some of the recent tools developed by the organization to support countries to sustainably manage their aquaculture species and related farmed types (such as strains, varieties and hybrids). Mr Vanderputte provided an overview of the main ongoing breeding programmes in European aquaculture, and Mr Pourkazemi provided a practical example of challenges and solutions in the management of endangered aquaculture species. The presentations were followed by a 30-minute panel discussion with questions from the audience.

SESSION 3

Markets for Aquaculture Products: Recent Changes and Trends

Was moderated by Mariana Toussaint, with the objective to present the main changes in recent years and some trends regarding the markets for aquaculture products at regional and global levels. Aspects associated with consumer tastes, product information and sustainability market requirements, among others, were also presented.

SESSION 4

Small in Scale, Big in Value: Celebrating the International Year of Artisanal Fisheries and Aquaculture

Was moderated by Alessandro Lovatelli and Austin Stankus with the objective of drawing attention to the International Year of Artisanal Fisheries and Aquaculture (IYAFA 2022). They presented the Global Action Plan and shared communication material to inspire action from European states represented at the conference and other participants.

The European Aquaculture Society conference saw participation of over 2 800 people, representing civil society organizations, producers, academics and students, underscoring the importance of the growing aquaculture sector. FAO welcomed this opportunity to host a Special Day, using it to strengthen professional connections while at the same time promoting FAO's work in the sector.

SEE ALSO

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Regional workshop on aquaculture value chain actors' practices of post-harvest management in Central Asia, Azerbaijan and Türkiye



Workshop participants discuss aquaculture value chains, post-harvest management and international fish trade.

A regional workshop was held in Bodrum, Türkiye, on 22–24 March 2022. The workshop was organized as a partnership between FAO and the Central Union of Aquaculture Producers of Türkiye (SUYMERBIR), and undertaken as a component of the “Capacity Development for Sustainable Fisheries and Aquaculture Management in Central Asia, Azerbaijan and Türkiye (FISHCap)” programme, which was developed and funded under the FAO-Türkiye Partnership Programme on Food and Agriculture (FTPP II). The workshop was attended by 43 participants from government agencies, research institutions and the private sector from Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Türkiye and Uzbekistan, with participants from Turkmenistan attending virtually.

The primary objectives of the workshop were to provide participants with an improved understanding of aquaculture value chains, post-harvest management and international fish trade. The workshop also provided an opportunity for participants to exchange experiences and discuss case studies and knowledge regarding aquaculture value chain development from their own countries.

At the start of the workshop, a series of technical presentations were delivered in the plenary by the staff of FAO, the United Nations Conference on Trade (UNCTAD) and regional universities for the purpose of providing participants with an improved understanding of

value chain theory, and dynamics of fish trade. The topics addressed included:

- Value chain theory, modelling and analysis, and applications and innovations in sustainable aquaculture value chain development; best practices for policymaking, including economic and social inclusion, social responsibility and biosecurity.
- An overview of international fish trade, the current situation and trends in aquaculture value chain development, food security, import notifications and non-tariff measures in international trade.
- Post-harvest management and the development of multidimensional solutions to address food loss.

Case studies describing aquaculture value chain development across the region were also presented. These included value chain analyses of the fish production sector in Kazakhstan, trout culture in Kyrgyzstan, carp culture in Hungary and the aquafeed value chain in Uzbekistan. The studies were followed by a series of reviews that focused on the development and lessons learned from the development of aquaculture value chains in Türkiye. The reviews explored various aspects of value chain development and management, including the role of farmer organizations, fish and feed production, processing, product branding, certification and traceability, marketing and trade, and gender inclusiveness in value chains.

The workshop closed with a launch event to mark the International Year of Artisanal Fisheries and Aquaculture 2022 (IYAFA 2022), and a visit to a fish processing facility and a fish farm, where participants viewed fish harvesting and processing procedures.

Written by:

Haydar Fersoy

FAO Regional Office for Europe and Central Asia, Budapest, Hungary

Regional workshop on aquaculture planning and policy development in Central Asia



Workshop participants discuss best practices in fish farm planning and development.

the importance of climate change, biodiversity and natural resource management in aquaculture planning. Other important issues addressed the use of aquaculture insurance for businesses and small-scale producers and the role of government agencies in supporting access to insurance. Promoting health and safety on farms was also discussed.

Using Türkiye as a case study country, participants were provided with an example of best practices

In June 2022, a five-day regional workshop was held from 13 to 17 June in Antalya and Isparta, Türkiye. It was organized as a partnership between FAO and the Central Union of Aquaculture Producers of Türkiye (SUYMERBIR). The workshop was undertaken as a component of the “Capacity Development for Sustainable Fisheries and Aquaculture Management in Central Asia, Azerbaijan and Türkiye (FISHCap)” programme, funded under the FAO-Türkiye Partnership Programme on Food and Agriculture (FTPP II). The workshop was attended by 36 participants from government agencies, research institutions and the private sector from Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Türkiye, Turkmenistan and Uzbekistan.

The primary objectives of the workshop were to: (i) provide participants with an understanding of the frameworks used for aquaculture planning and policy development; (ii) share Türkiye’s experience in this domain; and (iii) disseminate the tools to promote best practices in fish farm planning and development.

The workshop started with a series of technical presentations from FAO staff, representatives from the Ministry of Environment and research institutes of Türkiye, and the FISH Safety Foundation, a non-profit organization committed to promoting safe and sustainable fishing practices. The technical presentations provided a global overview of aquaculture planning and policy development. FAO supported the development of Guidelines for Sustainable Aquaculture (GSA) and their relevance to Central Asian aquaculture development, the ecosystems approach to aquaculture development, and

in aquaculture planning and policy development. Representatives of the Turkish government agencies, research agencies and producer organizations provided information on the Turkish government’s approach to develop the aquaculture sector, particularly the regulatory framework and the licensing and planning requirements to develop a fish farm. Topics under discussion were the government’s approach to aquaculture planning and policy development, mainstreaming gender to promote equality and for sectoral growth, the use of Geographical Information Systems in aquaculture planning and site selection, and the development of water use regimes and water quality monitoring for the sector. The licensing and regulatory issues were addressed and the license application process was described. The importance of environmental impact assessments (EIAs) in planning authorizations was discussed, as well as the types of environmental authorizations, their production thresholds, environmental monitoring requirements and the EIA application process.

In addition, participants were trained on how to plan and set up a farm. Presentations included site selection and the importance of species selection, water availability and quality, climate, soil characteristics, biological and operational factors, and economic and social considerations, as well as design processes and the role of prefeasibility and feasibility studies and farm design. The requirement for robust economic and market analyses and financial feasibility studies in the business planning process were noted, and case studies were presented.

The workshop closed with events to mark the International Year of Artisanal Fisheries and Aquaculture 2022 (IYAFA 2022) at Akdeniz University, the Mediterranean Fisheries Research, Production and Training Institute and the Eğirdir Fisheries Research Institute. Technical visits were made to a trout farm, in Isparta, and a fish processing plant.

Written by:

Haydar Fersoy

FAO Regional Office for Europe and Central Asia, Budapest, Hungary

Empowering young women for sustainable aquaculture in the Mediterranean and Black Sea



Trainees participating in the release of a loggerhead sea turtle in Monastir.

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The General Fisheries Commission for the Mediterranean (GFCM) of FAO organized a training on sustainable aquaculture practices for young women from Mediterranean and Black Sea countries to encourage them to take leadership roles in the aquaculture sector.

The seven-day training took 21 participants from 16 countries across Tunisia on a tour of some of the country's most successful and innovative aquaculture farms. The training was introduced by Maria Damanaki, former European Union Commissioner for Maritime Affairs and Fisheries, and included expert presentations and activities such as hands-on feeding and harvesting of fish, washing and repairing of nets, and snorkeling to observe and identify aquatic species. Organized within the framework of the International Year of Artisanal Fisheries and Aquaculture (IYAF 2022), proclaimed by the United

Nations to raise global awareness of the sector, the training shined a spotlight on small-scale aquaculture farms and their role in food security and sustainability.

The young women, selected for the training from among 150 applicants participated with GFCM staff and experts from the National Institute of Marine Science and Technology of Tunisia, non-governmental organizations and private sector entities working with small-scale aquaculture farms. The training strove to equip young women with new knowledge and skills to support their

Written by:

Matthew Kleiner
Intissare Aamri
Maissa Gharbi
Emna Derouiche

General Fisheries Commission for the Mediterranean



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full and effective participation and leadership at all levels of decision-making in the aquaculture sector. Properly recognizing the important role played by women in the industry is among the priorities of the **GFCM 2030 Strategy for Sustainable Fisheries and Aquaculture**, which aims to build an equitable and inclusive fisheries and aquaculture sector.

“Women play a vital role in fisheries and aquaculture all the way along the value chain. They rear and process fish, stock ponds and perform research, helping to support food security across the Mediterranean and the Black Sea. We have to support women in gaining knowledge and progressing in this sector,” said Houssam Hamza, GFCM Aquaculture Officer.

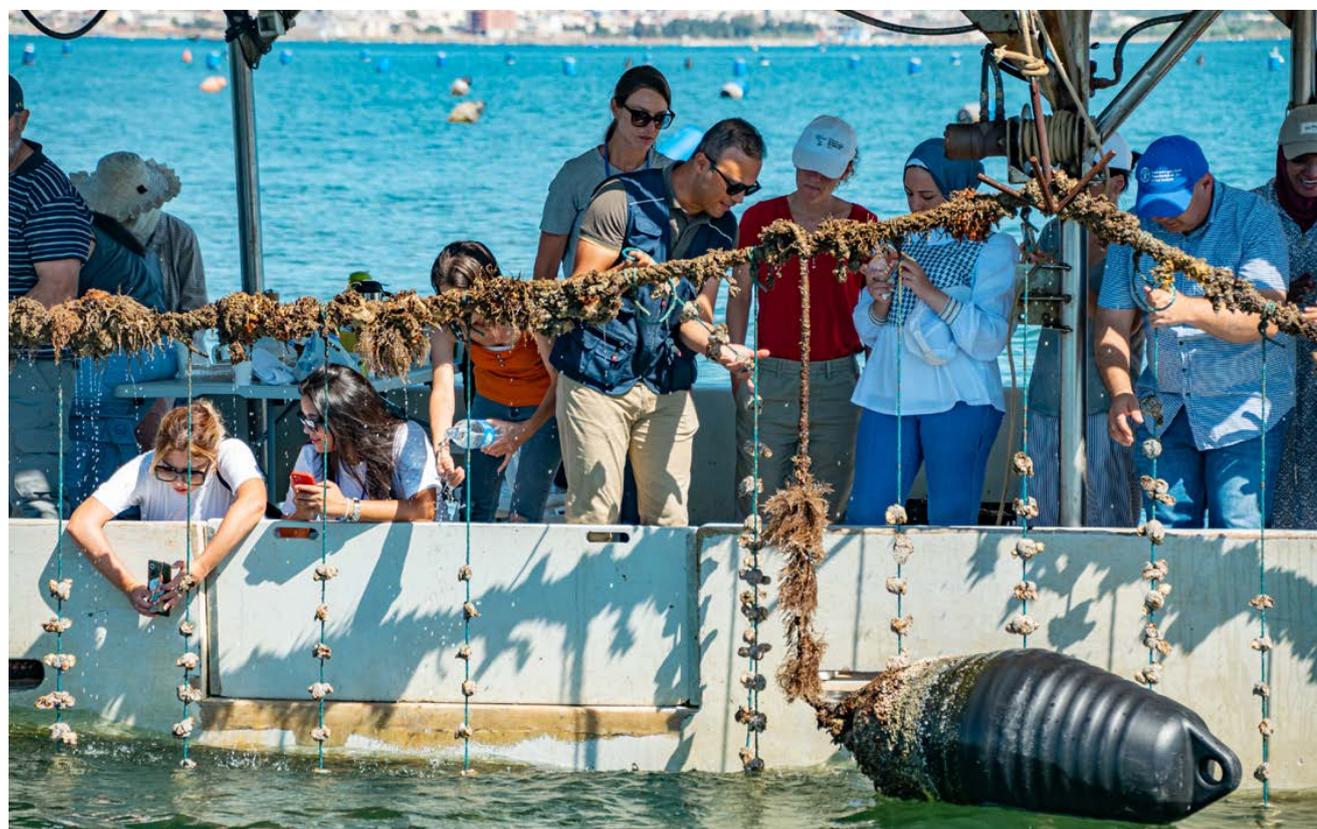
Though women account for a large part of the region’s aquaculture workforce (reaching 26 percent in some countries), their contributions are not reflected in the gender balance of leadership roles. The GFCM is helping to ensure women’s voices are heard by providing them with a strong basis for advancing in the field and empowering them in decision-making processes.

Among the aquaculture farms visited during the training, those in Monastir Bay, not far from the Kuriat Islands, offered participants the chance to observe how local aquaculture practices must be carefully balanced with the surrounding ecosystem – one of the most biodiverse in the Mediterranean and an important nesting site for loggerhead sea turtles and posidonia meadows – as well as with other blue economy activities such as tourism.



At the Biben Lagoon, 15 km from the Libyan border, the participants learned about sponge culture and extensive aquaculture harvesting and participated in farming activities. In the area of Gabès, the topic of the field trip was desert aquaculture and its opportunities for small-scale producers to integrate tilapia and spirulina aquaculture into the agriculture system. The final day of the training included a trip to the Bizerte Lagoon, where the potential of the burgeoning seaweed and shellfish farming industries is on full display.

“The best investment is in yourself. You always need to learn, develop and discover something new for yourself. These courses offer the opportunity to open new doors in aquaculture and beyond. It is important to have more women in the sector, because women can realize the full potential of aquaculture,” said Tamara Dombrovska, a training participant from Ukraine.



Participants learning about oyster aquaculture techniques in Bizerte Lagoon.

Promotion of resilient agri-aquaculture food systems in desert and arid countries in North Africa



Earthen pond used for fish production and crop irrigation in the district of Ouargla, Algeria.

©FAO/V. Crespi

There is an increasing need for expanding integrated agri-aquaculture (IAA) food production systems in arid and semi-arid areas to improve fish consumption by rural populations, as they often have limited access to quality animal proteins. They are also frequently among the poorest communities, as the extreme climatic conditions dramatically reduce their access to a variety of food and livelihoods. However, when significant freshwater or brackish water is available, it can provide important opportunities for the production of edible plants and aquatic food crops such as fish. Nowadays, the IAA farming systems are well known and the technologies allow for the production of aquatic animals even in arid conditions. Yet, IAA food systems and their components of production, harvesting, processing, marketing, distribution and consumption should be sustainable and resilient to prevailing climate conditions and changes.

The main constraints for the development of this aquaculture sector are the limited access to markets by producers and the social acceptability of freshwater fish by consumers. Since 2008, FAO has been engaged in the promotion and development of aquaculture in desert and arid lands through several technical cooperation projects in the Maghreb,¹ the organization of an expert workshop in Hermosillo, Mexico, in 2010² and other initiatives within the framework of the Water Scarcity Initiative for the Near East and North Africa (2013–2017).³

Written by:

Valerio Crespi
Emna Derouiche
Manahel Akkari

FAO Subregional Office for North Africa, Tunis, Tunisia

One recent initiative was a technical workshop entitled “Market system approach for resilient agro-aquaculture food systems in desert and arid countries” that was organized on 13–15 October 2022 in Tunis, Tunisia, by the FAO Subregional Office for North Africa. It was attended by 25 participants from Algeria, Egypt, Libya, Mauritania, Morocco, Oman and Tunisia. Participants included government officials, experts, private sector investors, scientific researchers and FAO officers. The overall objective of the workshop was the elaboration of a portfolio of investment project proposals for funding by interested donors in North Africa.

The participants presented a number of innovative and successful experiences of freshwater aquaculture in the Maghreb region, focusing on aquaculture production systems in arid lands and giving particular attention to aquaculture value chains. The market system approach used throughout the workshop allowed to better define the marketing and trading bottlenecks that limit access to aquatic animal farmed products. The workshop also provided an opportunity to identify key actors and assign responsibilities to national and/or regional institutions for concrete actions and funding to establish an enabling environment for the development of agri-aquaculture food systems in arid lands.

By the end of the workshop, ten project proposals were developed, presented and discussed among the participants. These proposals will be further elaborated to develop a portfolio of investment projects for funding by potential donors.

1. www.fao.org/3/CA2769FR/ca2769fr.pdf

2. www.fao.org/3/ba0114e/ba0114e.pdf

3. www.fao.org/3/ca8610en/CA8610EN.pdf

National workshop on capture-based aquaculture in Tunisian Dams: Potentialities and perspectives



Valerio Crespi, Fisheries and Aquaculture Officer (FAO-SNE), presenting FAO actions for the promotion and development of desert aquaculture (left), and Mohamed Naceur Dhraief, researcher from the National Institute of Science and Technology of the Sea (INSTM), presenting the latest advancements in artificial reproduction of flathead grey mullet (*Mugil cephalus*).

Within the framework of the International Year of Artisanal Fisheries and Aquaculture (IYAFa) the FAO Subregional Office for North Africa, in collaboration with the Higher Institute of Fisheries and Aquaculture of Bizerte (ISPAB), organized a national workshop titled “Capture-based Aquaculture in Tunisian Dams:

Potentialities and Perspectives”. The workshop was held 26–27 October 2022 in Bizerte, Tunisia. Stakeholders of the freshwater aquaculture sector were represented by government officials, experts, private sector investors, fisherfolk, students of ISPAB and scientific researchers.



Visit of the freshwater fish processing unit in Tabarka (left), and the tasting of value-added products made from freshwater fish harvested in the dams (right).

Written by:

Valerio Crespi / Emna Derouiche / Manahel Akkari
FAO Subregional Office for North Africa, Tunis, Tunisia

The workshop provided an opportunity to discuss issues related to the development of aquaculture in the dams of Tunisia and encourage young entrepreneurs to invest in this area. The main objective was to provide participants with an improved understanding of the potential development of capture-based aquaculture in Tunisian dams, aquaculture value chains and promotion of value-added products.

The first day was devoted to a series of presentations delivered by experts in inland fisheries and aquaculture, who focused on socioeconomic aspects (marketing, processing, profitability, administrative procedures and zoosanitary registration) and technical aspects (stock assessment, fish stocking in dams, and recent scientific advances such as artificial reproduction of flathead grey mullet, *Mugil cephalus*).

On the second day, a field trip was organized to visit the freshwater fish processing unit in the town of Tabarka, in the northwest of the country, with a view to strengthening the knowledge of fish handling and processing of aquatic products grown in these dams.

This visit was followed by a tour to the Sidi El Barrak Dam to meet small-scale fishers to discuss their constraints, needs and possible solutions that would enable the development of this subsector. As an added benefit, the tour provided a welcome chance to taste various value-added products made from freshwater fish harvested in the dam.

At the end of the 2-day workshop, it was decided to establish a task force composed by selected experts who attended the event to follow up with the recommendations and to be in charge with the organization of a second edition of this workshop to be organized in 2023.



Sidi El Barrak Dam (Nefza), northwest Tunisia.

©FAO/W. Crespi



A floating cage for tilapia production in the dam of Lahjar in governorate of Nabeul, Tunisia.

©FAO/M. Akkari

Aquaculture Development Program Conference in King Abdullah University of Science and Technology, Saudi Arabia

King Abdullah University of Science and Technology (KAUST) was founded in 2009, and within 10 years it was ranked eighth among the fastest rising young universities in the world for its research output. KAUST collaborated with the Saudi Ministry of Environment, Water and Agriculture on science-based research in support of Vision 2030, which is Saudi Arabia's strategic socioeconomic blueprint. Under the strong partnership, a conference on aquaculture development was held from 4 to 6 September 2022 in Jeddah, Saudi Arabia. The objective of the event was to showcase the Aquaculture Development Program (ADP), a government-sponsored initiative implementing applied research for the development of aquaculture in the country, which targets to reach 530 000 tonnes of aquatic food by the year 2030. The conference reviewed the past five years of research on commercial aquaculture species and provided guidelines to address the new challenges of production and market.

The three-day conference, opened by Ali Alshaikhi, General Director of Fisheries Resources of Ministry of Environment, Water and Agriculture, gathered many national and international experts. The technical sessions started with presentations about new challenges and plans, complementing the information about the objectives already achieved. Seafood markets, trends, financial support, best practices and opportunities in the Gulf Cooperation Council (GCC) countries were discussed. Discussion on the latest advances in research, biosecurity, genetics and value chains closed the first day. The second day analysed in more detail several aspects of hatcheries, the ADP research results conducted for the existing species cultured in the country, and potential new species (for example, *Argyrosomus regius*, *Trachinotus blochii* or *Sparidentex hasta*) for marine aquaculture in the Red Sea with particular emphasis on nutrition and environmental effects on aquaculture production. On the last day, contributions on algae production and fisheries management paved the way to an extensive environmental session dealing with aquaculture siting, environmental monitoring, aquaculture carrying capacity, and provisional modelling for pollutants as well as modern technologies to determine the presence of species through e-DNA.

The aquaculture sector in Saudi Arabia has shown impressive growth and improvement in the past five years.

Written by:

Pedro Guemes

Kakoli Ghosh

FAO Sustainable Rural Agriculture Development Programme, Riyadh, Saudi Arabia



Tilapia production in Eastern region of Saudi Arabia.

Several coordinated activities are seen in the improvement of sustainability, biosecurity, capacity building, diversification, and feeding efficiency. Nevertheless, the plans for the next years continue in the same ascending and challenging process. Diversification, trends and financial support would strengthen the sector and increase its resilience. Cooperation with GCC countries, addressing common subjects, will enhance the results so far achieved especially in the Blue Transformation fields.

Biosecurity in Saudi Arabia is very solid with a clear orientation; the experience may guide GCC countries in reaching a successful regional biosecurity system. Hatcheries and feeding improvements need some attention and support, and the updated results of several research projects would produce clear scientific recommendations to address the current difficulties.

Microalgae and seaweed production are in their first stages of development, and previous experience in other countries show positive results with impressive benefits for the global environment.

Aquaculture is strongly linked to capture fisheries and marine ecosystems: digital monitoring systems founded on the ecosystem approach rationale would allow for a positive coordination within the Blue Transformation Roadmap 2022–2030.

Finally, new technologies such as e-DNA, artificial intelligence, computational chemistry and digital systems are expected to be incorporated to support automatization for data retrieving.



Tilapia hatchery in Eastern region of Saudi Arabia.

Mapping offshore aquaculture potential in the coastal waters of the United Arab Emirates



Offshore oyster farm, Dibbah, Fujairah, United Arab Emirates.

Technical cooperation between the United Arab Emirates (UAE) and the FAO Subregional Office for the Gulf Cooperation Council States and Yemen (SNG) supports the UAE Government's National Food Security strategy through an initiative dedicated to the aquaculture sector: "Launch a National Aquaculture roadmap".

The UAE population consumes, at about 25.3 kg per capita, more seafood than the global average. This requires fish production in quantities that outpace the current national production, which, in 2018, stood at around 3 000 tonnes. In a business-as-usual scenario, fish production would increase to 4 500 tonnes. The UAE National Aquaculture roadmap foresees a tenfold multiplication in production to 30 000 tonnes by developing cage culture on its two coastlines, along the Gulf and the Sea of Oman.

The UAE Aquaculture Atlas identifies and prioritizes suitable sites for cage aquaculture systems, a key development factor

Written by:

Martin van Brakel

Patrick White

Alessandro Ciattaglia

FAO Subregional Office for the Gulf Cooperation Council States and Yemen

for aquaculture to be implemented under the National Aquaculture roadmap initiative. The prioritization takes technical and environmental considerations into account and considers criteria for reduction of conflicts with other users in the increasingly saturated coastal and offshore domains within the UAE territory. The site identification is also the starting point for carrying capacity estimation of the identified aquaculture zones.

Potential offshore fish farming areas are ranked using a procedure of multi-criteria analysis integrated into a Geographic Information System (GIS) to aid in the planning and selection of suitable zones for offshore cages. The use of geotechnology in this process represents a significant advancement over conventional procedures for prioritization. It involves a probabilistic approach to analysis incorporating multiple criteria with different values. Depth, distance from shore, wave height, currents, salinity and algal bloom risks are the principal selection criteria. These criteria are ranked according to 6 classes of suitability (from 1 = unsuitable to 6 = highly suitable) in relation to the specific environmental and hydrographic conditions present in UAE offshore locations. Their respective weights of importance are based on expert opinion. A GIS database represents the spatial distribution of the factors involved. The resulting suitability scores are

normalized to produce a final map of relative suitability within 50 km from the UAE coast (mainland and islands). The map identifies restricted areas and applies a specified buffer distance around such areas to determine their exclusion zones. Both qualitative and quantitative information are considered in this process. Not all factors could be derived directly from mapped data. Sea current speed, significant wave height and average tidal fluctuation data did not cover the entire area of interest and had to be derived by proxy from secondary data.

The basis for decision-making lies in the criteria and subcriteria, represented by factors and constraints. Bathymetry, wave height and sea current speed are key determinants for a cage farm design. These variables determine the energy characteristics of each site considered for possible fish farming. Three different cage technologies are proposed, for low, medium and high energy sites, respectively.

Suitable low energy site conditions where floating cages with a diameter of 25 m can be deployed are present in the nearshore and inshore locations in the shallow southwestern area of the Gulf. This area is characterized by low residual current flows and high salinity. The shallow area extends far out from the mainland shore and scores poorly in the overall suitability analysis. Large annual differences in sea surface temperature (SST) and high summer SST exceeding 30 °C combined with hypersaline conditions exceeding 40 psu restrict the choice of culture species. *Cobia (Rachycentron canadum)* is highly tolerant to harsh environmental conditions and could be the culture species of choice, particularly in shallow inshore areas. Several islands in this area are located at short distance to water depths from 25 m to 35 m suitable for cage culture and could support shore-based facilities for large-scale aquaculture. Nearshore areas are restricted for aquaculture in terms of potential impacts on landscape and visual seascape. Two large marine protected areas, Al Yasat (National) and Marawah Marine Biosphere Reserve (UNESCO), are designated important in terms of coastal and marine biodiversity conservation.

Offshore locations offer suitable conditions for medium energy sites. Larger floating cages with a diameter of up to 38 m can be deployed further offshore in the southwestern area of the Gulf and off the main coast along the northeastern Gulf, where depths range between



Offshore floating cage farm, Dibbah, Fujairah, United Arab Emirates.

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30 m and 40 m. The area is located away from marine protected areas and tourism sites. Potential impacts on landscape and visual seascape, recreation and tourism are negligible here. Offshore environments also offer more space and more dispersive environments for dilution of wastes and reduced negative impact. Annual differences in SST are less pronounced in the northeastern Gulf. Higher carrying capacities justify larger farms here and the choice of culture species is less restricted. Barramundi (*Lates calcarifer*) and European seabream (*Sparus auratus*) are considered suitable culture species for these medium energy sites. On the downside, moving further offshore incurs higher operation and servicing costs. Intensive marine shipping traffic limits the space offshore for cage aquaculture as well. Major oil terminals and their associated tanker anchorages are exclusion zones situated in these areas.

Areas with suitable water depth ranging between 25 m and 50 m at relatively short distance from shore are available toward the northeastern limit of the Gulf shoreline. The overall conditions for cage aquaculture development along this part of the coast are good. The results from the multi-criteria analysis confirm that the suitability for cage aquaculture increases towards its northeastern range. The UAE east coast on the Sea of Oman at depth ranges between 60 m and 70 m offers suitable conditions for submersible cages. European seabream can be successfully farmed in submersible cages and is recommended for culture in these sites.



Sea urchin, *Paracentrotus lividus*, in its natural environment.

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Raising awareness on sustainable aquatic food systems during Expo 2020 Dubai

From 1 October 2021 to 31 March 2022 – after one-year postponement because of COVID-19 – the United Arab Emirates hosted World Expo in Dubai, which attracted 24 million visitors from all over the world. With the motto “Connecting Minds, Creating the Future”, it was a perfect occasion for FAO to raise awareness on the Blue Transformation, the socio-technical challenges, and the opportunities that fisheries and aquaculture offer for the future of our food systems.

On World Food Day 2021, celebrated every year on 16 October, FAO produced a video promoting the International Year of Artisanal Fisheries and Aquaculture (IYAFA), which was broadcast during the launch of the Hammour House project, an Expo 2020 landmark raising awareness on marine ecosystems through art and handicrafts.

On 22 January 2022, the event “Life Below Water: Progress Toward SDG 14 and Way Forward” was jointly organized by FAO and the Ministry of Climate Change and Environment of the United Arab Emirates. Gathering experts from FAO headquarters, federal and other authorities of the United Arab Emirates, Norway, which the Expo 2020 pavilion highlighted fisheries and aquaculture, and the Hammour House project, the event took stock of the progress made so far towards achieving the various targets of SDG 14 and discussed options to move forward.

Exactly one month later, on 22 February 2022, a high-level event took place that focused on “Blue Transformation and climate change in the GCC states and Yemen”. Participants included the Minister of Agriculture and Fish Wealth of Yemen, the Assistant Director-General of FAO for Near East and North Africa, the Director of the Fisheries and Aquaculture Division of FAO, and



High level panel discussing Blue Transformation and climate change in the GCC states and Yemen.

numerous undersecretaries and high authorities from across the region. This event was an opportunity to introduce the Blue Transformation and start building a momentum towards the United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties 27 (COP 27) in Egypt and COP 28 in the United Arab Emirates. During the discussions, it was noted that fisheries and aquaculture were at the forefront of climate change and recommendations were formulated, in particular, to reassess the blue carbon resources in the region but also to make sure that people are at the centre of the UNFCCC COPs discussions and solutions.

On 24 February, FAO was also invited to give a keynote presentation on the role of the ocean in feeding a growing world population on the occasion of the visit of H.E. Bjørnar Selnes Skjaeran, Norway’s Minister of Fisheries and Ocean Policies. Lastly, a few hours before the final closure of Expo 2020, FAO supported the Fujairah Environment Agency in the organization of the fourth Fujairah International Conference for Coastal Areas and Marine Environment 2022.



Art installations at Expo 2020 used sculptures and handicrafts to raise awareness of the essential role of aquatic ecosystems.

Written by:

Lionel Dabbadie

Fatima AlKatheeri

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

Rumaitha Abdulaziz Alshehhi

Ministry of Climate Change and Environment, Dubai, United Arab Emirates

Fatima Rashid Al Hantoubi

Fujairah Environment Agency, Fujairah, United Arab Emirates

SEE ALSO

Life Below Water: Progress Toward SDG 14 and Way Forward (video): <https://twitter.com/FAOinUAE/status/1486974683652435971>

Blue Transformation and Climate Change in the GCC States and Yemen (video): <https://twitter.com/FAOinUAE/status/1512362087636418561>

Working together with Shanghai Ocean University towards a Blue Transformation

In an online event, the FAO and Shanghai Ocean University (SHOU) agreed to work together in the future by signing a Memorandum of Understanding on 5 November 2022. The two organizations have a longstanding relationship in which they share information and harness science and innovation for aquaculture blue transformation.

The online event, as part of SHOU's 110th anniversary celebration, was opened with a short speech on the new collaboration of the two organizations. Afterwards, Manuel Barange, Director of the Fisheries and Aquaculture Division and as representative of the FAO Director-General, delivered a statement. Professor Wan Rong, President of the Shanghai Ocean University, replied that SHOU looks forward to the cooperation.

During the past decades, FAO has maintained a close relationship with SHOU. Since the early 1980s, FAO has collaborated with the university on aquaculture, fishing and aquatic product processing training programmes, and with the exchange of Southeast Asian aquaculture technicians. Meanwhile, many SHOU graduates have joined FAO to contribute their expertise, and others are involved in global fisheries and aquaculture governance.

FAO has established a number of international research and development projects in which SHOU, as one of China's leading universities in the field of fisheries and aquaculture, has actively participated. The fields of sustainable fisheries, deep-sea fisheries management beyond national jurisdiction, port state measures, trade and market management of aquatic products, and frozen storage of aquatic products have also played a significant role in the preparation of FAO's fisheries and aquaculture guidelines. Since 2017, FAO and SHOU have co-hosted a number of international conferences and organized workshops on major issues, such as the international trade and market for aquatic products, the sustainable value chain of aquatic products, and the international promotion of rice-fish farming systems demonstrating "SHOU wisdom" for sustainable development.

Written by:

Min Jiang

Shanghai Ocean University, Shanghai, China

Kang Li

FAO Fisheries and Aquaculture Division, Rome, Italy



Signing ceremony of the Memorandum of Understanding between FAO and SHOU.

SHOU's engagement in the FAO-led global fishery governance system has become more in depth, and it has steadily created an international cooperation network with several international organizations in the field of fisheries and aquaculture, such as the International Council for the Exploration of the Sea, Network of Aquaculture Centres in Asia-Pacific, Organisation for Economic Co-operation and Development and WorldFish.

FAO and NACA, in collaboration with the Ministry of Agriculture and Rural Affairs (MARA) of China, successfully co-organized the Global Conference on Aquaculture Millennium +20 in September 2021, which was the fourth in a series of development-focused



Workshop on the Marine Resources Assessment at the Shanghai Ocean University with FAO and the United Nations Development Programme.

conferences that have shaped global aquaculture. SHOU co-hosted the event alongside the Bureau of Fisheries of MARA and the China (Shanghai) Pilot Free Trade Zone Lin-gang Special Area Administration.

SHOU established the Center for Ecological Aquaculture (CEA). Aligned with the FAO Blue Transformation initiative, CEA is committed to becoming a leading global academic institute in sustainable aquaculture development, dedicated to promoting sustainable aquaculture development, especially the ecological dimension, and to supporting the transition of global food production towards more sustainable, ecologically sensitive aquaculture practices. SHOU will continue to focus on and serve the Sustainable Development Goals (SDGs), particularly No Poverty, Zero Hunger, and Life Below Water, as well as FAO's Blue Transformation initiative, in the future.

One ongoing area of work is taking place in two northern provinces of the Lao People's Democratic Republic, where SHOU through the CEA is supporting the sustainable intensification of integrated agriculture-aquaculture

(IAA). This work has included an assessment of the current status of the country's integrated farming, a report on opportunities and challenges, and proposals to enhance the promotion of IAA based on surveys and interviews with the Lao farmers. CEA has also produced technical materials on IAA, including guides, teaching videos and virtual courses, which detail successful Chinese techniques and models of IAA and their applicability to the Lao People's Democratic Republic, all available in Lao. A detailed survey on biodiversity of aquatic organisms in rice fields was also carried out, identifying 51 species that are extremely important resources for farmers living in rural areas, which may not be replaced easily by other food. Unfortunately, the initial results suggest that the current biodiversity may be affected by increasing levels of agricultural inputs.

With this long history, the new Memorandum of Understanding and shared vision for a world in which aquaculture makes its maximum contribution to the SDGs, FAO and SHOU look forward to a long and fruitful collaboration.



Opening ceremony of the Global Conference on Aquaculture Millennium +20, organized as a hybrid event.

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Outreach services to support the promotion of integrated agriculture-aquaculture in the Lao People's Democratic Republic as a tool to improve food and nutrition security and reduce poverty (first international project at the Center for Ecological Aquaculture).

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SEE ALSO

Global Conference on Aquaculture: www.aquaculture2020.org

Native seaweed farms in India: An interview with Gabriella D’Cruz provides the perspective from a young female entrepreneur

Seaweeds are versatile aquatic species that are receiving growing attention as a key candidate for restorative aquaculture that can generate both socioeconomic and environmental benefits. While world seaweed aquaculture production has increased by 1 000 times, up from 35 000 tonnes (wet weight) in 1950 to 35 million tonnes in 2020, the impressive global development nevertheless has been concentrated in only a few countries. In 2020, seaweeds were cultivated in 43 countries or territories, yet in only seven countries did the production exceed 100 000 tonnes, and all of them are in Eastern and Southeastern Asia. Outputs of the other 36 countries, those producing less than 200 000 tonnes including India, represented merely half a percent of world total. India’s seaweed aquaculture production grew from less than 1 000 tonnes in the early 2000s to 5 300 tonnes in 2020. Ranked 14th among all 43 seaweed farming countries notwithstanding, India’s seaweed aquaculture contributed merely 0.015 percent of world production, which was much lower than its share of world population (18 percent) and coastline length (0.9 percent). India is the third largest aquaculture country, and the second largest when seaweeds are not counted. Its long coastline of approximately 7 000 km provides suitable farm sites for seaweed aquaculture. The country’s population is expected to reach 1.5 billion in 2030 (the largest among all countries), and a large and increasing proportion of the population follow a plant-based diet. With all these enabling factors, there is little doubt that India has a great potential in seaweed aquaculture, yet the question is how to unlock the potential, especially since seaweed production and consumption are relatively new to the country.

In this article, Gabriella D’Cruz, a seaweed believer and entrepreneur, shares her thoughts in an interview with FAO Aquaculture Officer Cai Junning on how to unlock the potential of seaweeds in India based on her experience under a pilot project on Native Seaweed Farms India. The project was one of the eight winners of a competition under the Youth for Green and Climate-Resilient Agriculture (YCRA) programme, an event launched by the International Association of Students in Agricultural and Related Sciences (IAAS) in collaboration with FAO.

Written by:

Cai Junning

FAO Fisheries and Aquaculture Division, Rome, Italy

Gabriella D’Cruz

The Good Ocean, India



Gabriella D’Cruz harvesting and monitoring seaweed.

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So Ms D’Cruz, what attracted you to the seaweed business?

“I have always been interested in how people in coastal communities self-organize themselves to run seafood businesses. While conducting research for my master’s thesis, I met some incredible women who harvested wild seaweeds around the islands in the Gulf of Mannar in Tamil Nadu, India. These women would take a boat out into the sea in the early morning and bravely dive in the water to gather a variety of seaweeds. They told me about various hardships in their work and how they struggled to earn a living with declining seaweed stocks and fluctuating markets. What they needed the most was better equipment, better seaweed drying facilities and a higher pay for their seaweeds. It was then that I got motivated to look at the potential of creating a seaweed supply chain that could benefit coastal communities. It has been four years since I met these amazing women, and it is now my first year running my own seaweed food company.”

Could you tell us about your project on Native Seaweed Farms India?

“I run a consultancy called The Good Ocean through which I have worked with companies interested in sourcing sustainable seaweed for their products. In 2021, I teamed up with EcoNiche Consultancies and another local partner to set up a pilot Gracilaria farm off the coast in Kumta, Karnataka. The farm encountered a series of challenges, including an unseasonal cyclone and a disease outbreak that damaged most of the crop. These hardships made us aware of the challenges of seaweed farming and the need of technical and funding support in order to make our project scalable. In our quest for support and partnership, we submitted a project (called “Native Seaweed Farms India”) to the YCRA programme, which fortunately became one of the winners. The pilot project is focused on establishing a robust seaweed farming model in the west coast of India. Through the project, as well as the mentorship programme organized by IAAS/FAO, we have received tremendous support from many seaweed experts and extended our network in the global seaweed community.”

Like most tropical seaweed aquaculture, India has been focused on cultivating *Eucaema* seaweeds, primarily *Kappaphycus*, which are alien species in India. Yet you focus on native seaweeds – why?

“India’s fascination with *Kappaphycus alvarezii* is somewhat understandable, considering the large, established global market for this important industrial raw material. However, India has over 800 seaweed species that could have a range of benefits to the local biodiversity as well as diverse market applications. So we believe that native seaweeds in India deserve more attention, research and funding to explore their potential, and we would like to contribute our efforts. We know it will not be easy, but even if our pilot project may not eventually become an established business, our efforts will still be worthwhile. Besides, our current focus is on seaweed as food, working on native seaweeds would give us some strategic advantages in the long run.”

What are your business strategies and plans?

“I extended The Good Ocean into a small food business, which monitors local seaweed forests in Goa and harvests a controlled amount of local seaweeds for sale to chefs and restaurants across the country. We target high-end markets to promote seaweed consumption among customers who are conscientious about the origin, safety and sustainability of food products as well as the socioeconomic and environmental implications of their food consumption. We aim at increasing the number of collaborating restaurants, and we are in the process of developing a few customary products such as seaweed burgers and seaweed seasonings. In the long run, we hope to find ways to integrate seaweeds into traditional Indian cuisine and daily dishes, only by which can a robust industry based on native seaweeds be established in India. Although we currently do not plant what we harvest, we do care for our “crop” and make sure our operations do not harm the local ecosystem. We are conscious that more sophisticated farming operations tend to be needed in the long run to satisfy growing demand for local seaweeds, and we will use our experience with wild seaweeds to be prepared for this future.”

Tell us about your perceptions and visions about your seaweed enterprise. How do you plan to turn your visions into reality?

“I enjoy running our seaweed food business. Although still very small, our company is the first and only supplier of food grade seaweed from local sources to our customers, and our work has received a lot of attention. We hope to become a responsible seaweed food company that operates not only for economic gains but also for socioeconomic and environmental benefits. If our business model succeeds, it would hopefully encourage others to follow or build on. I particularly would like to see more women working in the seaweed sector. As in most parts of the world, women are the backbone of the fish processing industry, yet they receive little recogni-

tion, income and decision-making power. I see many women taking up seaweed businesses in India recently, and it is empowering to

see how women are making a place for themselves in this sector. I hope to be just one of a new wave of women in aquaculture, and will actively encourage other women to pursue it too.

India currently views seaweed through the lens of Japanese cuisine (such as sushi wraps or ingredients in miso soup). We really need to better celebrate the diversity of seaweeds along our coastline and learn to better integrate them into our diets. Our long-term goal is to make Indian people eat more seaweed and to build integrated seaweed and mussel farms along our coast that can supply a range of healthy food from the ocean.

As a marine conservationist now running a seaweed food company, I feel the pressure of growing a business while also safeguarding the ecosystem that underpins the business. There are many unknowns, things to learn and various obstacles (expected or unexpected). I constantly consult experts to ensure that I am putting in safeguards to harvest wild seaweed responsibly. I also try to keep up with the latest seaweed research, especially when it comes to the applications of seaweed as a new low carbon food source for India.

The good thing is that I am not doing this alone. I strongly believe that collaborations among stakeholders and experts will be crucial for a sustainable industry based on native seaweeds to emerge. Our work on establishing seaweed supply chains involves developing guidelines for the monitoring and sustainable harvest of seaweeds as well as ensuring a fair and competitive earning for coastal communities interested in harvesting seaweeds. In doing so, we hope to attract more efforts in promoting sustainable production and consumption of native seaweeds in India. We are also actively looking to collaborate with research organizations to monitor local seaweed forests along our coastline in Goa to understand what the larger Indian seaweed ecosystem needs to grow better. At the same time, we engage with a range of stakeholders (government, local communities, chefs and other innovators, etc.) to explore market and business opportunities to utilize local seaweeds as alternative livelihood sources in coastal communities. By working together, I look forward to a future when seaweeds are no longer just an Asian food but become a local food accessible to everyone in India.”



Packaged seaweed products from *The Good Ocean* for business to business sales to chefs and restaurants in India.

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SEE ALSO

Youth for Green and Climate-Resilient Agriculture www.fao.org/climate-change/programmes-and-projects/detail/en/c/1504698/

International Association of Students in Agricultural and Related Sciences www.iaasworld.org/about



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Strengthening resilience of small-scale farmers and farming systems to climate change impacts through aquaculture: A regional perspective



©FAO/K. Hamptak

Integrated agriculture model under the sufficiency economy philosophy (SEP) at Ban Nong Kham, Nai Muang Sub-District, Wiang Kao District, Khon Kaen, Thailand.

Aquaculture is an important source of food, nutrition, income and livelihoods for tens of millions of people around the world. The global climate is changing and its impacts, associated with the accumulation of greenhouse gases in the atmosphere from human activities, are causing changes in mean temperature and shifts in rainfall patterns and seasons. The intensity of extreme weather events is increasing and is predicted to worsen in the future. Many people, particularly those in developing countries, are facing shortages of water and food and are at greater

risk for climate-related health impacts. Therefore, it is critically important to address climate change challenges, especially in many Asia-Pacific countries, which are highly vulnerable to climate change.

The impacts of climate change are serious and must be addressed now because the longer we fail to take action, the bigger the cost to remediate the impacts. Preemptive mitigation of climate change is a key consideration for the present-day sustainable development of the sector.

Written by:

Cherdsak Virapat

Centre on Integrated Rural Development for Asia and the Pacific

Jie Huang

Network of Aquaculture Centres in Asia-Pacific

1. Virapat, C., Wilkinson, S. & Soto, D. 2017. FAO Fisheries and Aquaculture Proceedings 45. Developing an Environmental Monitoring System to Strengthen Fisheries and Aquaculture Resilience and to Improve Early Warning in the Lower Mekong Basin. FAO/NACA Workshop, 25–27 March 2015, Bangkok, Thailand.
2. Johnson, J., De Young, C., Bahri, T., Soto, D. & Virapat, C., eds. 2019. *Proceedings of FishAdapt: the global conference on climate change adaptation for fisheries and aquaculture, Bangkok, Thailand, 8–10 August 2016*. FAO Fisheries and Aquaculture Proceedings No. 61. Rome, FAO. 240 pp.

The Network of Aquaculture Centres in Asia-Pacific (NACA) and the Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP) and their partners have played a vital role in implementing many activities for climate change mitigation and adaptation in fisheries, aquaculture and agriculture, improving knowledge of climate change and related natural disasters and their impacts for policymakers, researchers, development practitioners and other stakeholders, and strengthening related adaptive capacities. NACA collaborated with FAO on a country review and on organizing a workshop in 2015 on developing an environmental monitoring system to strengthen fisheries and aquaculture resilience and to improve early warning in the Lower Mekong Basin.¹ NACA also collaborated with FAO on organizing FishAdapt: The Global Conference on Climate Change Adaptation for Fisheries and Aquaculture in Bangkok, Thailand, in 2016.² Simultaneously, CIRDAP, in 2021, collaborated with NACA by proposing a project proposal for the European Union Horizon 2020 Initiative entitled “Making Information and Communication Infrastructure Resilient to Climate Change for Community-based Climate Smart Farming Practices”. Lastly, on 9 September 2022, CIRDAP awarded the Aziz-Ul Haq Rural Development Medal to FAO for its contributions to promote integrated rural development for small-scale aquaculture and agriculture farmers.

Most countries in the Asia-Pacific region have responded to climate change challenges by formulating climate change strategies, action plans, policies and disaster management measures. A number of institutions and funds have also been established to support policy implementation. Despite the significant initiatives and policy frameworks, however, Asian-Pacific countries are still facing challenges responding to climate change impacts, which need to be overcome to improve climate resilience and livelihoods. Many countries in the region lack capacity to reduce risk and respond to climate change, and as a result, agricultural and aquaculture production as well as rural alternative livelihood activities are hampered.

To overcome these challenges, four strategic actions need to be established as regional initiatives:

- Increasing climate resilience of farmers, farming systems and breeds available for farming.
- Increasing capacity to manage short- and long-term climate risks and reduce losses from climate-related disasters.
- Improving sustainability of genetic diversity in broodstock as a resource for long term, continuous adaptation to climate change.
- Finding the potential and developing the capacity of aquaculture in mitigating the impact of and/or reducing or sequestering greenhouse gas emissions.

NACA and CIRDAP, in collaboration with FAO and the United Nations specialized agencies, their member countries and partners, are planning to meet to discuss and develop targeted programmes for countries in the Asia-Pacific region.

It has been suggested that combined efforts should be made in setting up a decision-support platform for a regional climate change impact assessment that would produce risk maps showing locations with the possible effects of climate change on aquaculture and agriculture in different member countries of NACA and CIRDAP over the next 15 years (increasing temperature, change in rainfall patterns, intensity and frequency of storms, increase of CO₂ levels and sea level rise).

This decision-support platform would provide reliable and up-to-date information and a decision-support system for governments, private sector, industry and farmers to make informed choices about how these stakeholders should be adapting their aquaculture and agriculture systems and related industries to climate change; defining adaptation strategies for the main environmental, disease and genetic threats caused by climate change to inform and guide local community organizations or cooperatives; communicating the results of the vulnerability assessment and adaptation planning and strategies at all levels; and implementing pilot projects on adaptation and providing capacity building required to better manage farming systems.

NACA and CIRDAP and their country members and partners will collaborate and cooperate with FAO and other United Nations specialized agencies for building climate resilience in aquaculture and agriculture systems to support 500 million³ small-scale and subsistence farmers in the Asia-Pacific region.⁴ Government authorities and policymakers can use the Guidelines for Sustainable Aquaculture for capacity development and adaptive management at national and local levels.⁵



Rows of floating vegetables growing as a climate resilient farming model in Gopalganj, Bangladesh.

©U. Boruah, CIRDAP

3. Lowder, S.K., Scoet, J. & Raney, T. 2016. The number, size, and distribution of farms, smallholder farms, and family farms worldwide. *World Development*, 87: 16–29.
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Colleagues in motion



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Annika Kolbe

Annika Kolbe is a political science master's degree student at the University of Konstanz, in Germany. She is taking courses in sustainable rural development, climate change, as well as biology courses in zoology and ecology. Previously, she studied at Sciences Po, in Paris, and at Ludwig-Maximilians University of Munich. In the summer of 2022, she worked as a volunteer for Dr Matthias Halwart and Austin Stankus. After she finishes her master's degree, she would like to pursue her great interest in working in the environmental policy field and more specifically in fisheries and aquaculture.



Emma Hemmerlé

Emma Hemmerlé is a French national who joined FAO's Fisheries and Aquaculture Division in October of 2022, specifically working as an intern with the team focusing on aquatic genetic resources. Emma is a biodiversity conservation and natural environment management specialist, having received an undergraduate degree in conservation of biodiversity at University College London, in the United Kingdom, and a master's degree in sciences and management of nature at the University of Bologna, in Italy. Emma's education has been multidisciplinary in nature, and she has had experience working on nature conservation related issues, in research, in the science-policy interface, and within non-governmental organizations. Emma is thrilled to be joining FAO, and is hoping to further her knowledge on the questions surrounding fisheries and aquaculture management, as well as discover the inner workings of a large international agency such as FAO.

Emma Hemmerlé can be reached at: Emma.Hemmerle@fao.org



Xinting Shao

Xinting is a Young Professional Officer specializing in aquaculture technology and production. She holds a Bachelor of Science degree in aquaculture from Huazhong Agricultural University, China, and a Master of Science degree in aquaculture biology from the University of Bergen, Norway. She has worked in China, Malta and Norway. In Norway, she worked at Uni Research AS as a research technician raising cute zebrafish for genetic research while also studying biology (and Norwegian) in Bergen. In Malta, she started as an intern at an aquaculture company and was offered a full-time job later as an aquatic researcher carrying out investigative research on new products at recirculating aquaculture facilities. After completing her studies abroad, Xinting served as an assistant to diplomats in European diplomatic missions in Beijing, China, a consultant for a Portuguese consulting firm specializing in research, technology and innovation (RTI), and a government affairs desk coordinator at the European Union Chamber of Commerce in China.

Before joining FAO, Xinting was responsible for providing technical support for the development and implementation of several European Union-funded projects that aimed at facilitating European Union-China cooperation on RTI. For example, the "European Network of Research and Innovation Centers and Hubs, China (ENRICH)" was funded by the European Commission's Horizon 2020 programme to offer services to connect European RTI stakeholders to their Chinese counterparts.

Xinting Shao can be reached at: Xinting.Shao@fao.org



Yixue Li

Yixue Li (Katy) is a Chinese national who just started a six-month internship at FAO's Aquaculture Branch in October 2022. During her time here, she will be working primarily with the group responsible for aquatic genetic resources (AqGR) for aquaculture. She considers herself a data analyst, having earned a Bachelor of Science degree in data science from the University of Melbourne. At FAO, Yixue will be supporting the AqGR with quantitative modelling analysis, finalization of the thematic review publications and harmonizing terminology for AqGR. Yixue is particularly interested in data exploration and quantitative analysis to provide significant insights for selective breeding and genetic administration.

Yixue Li can be reached at: Yixue.Li@fao.org

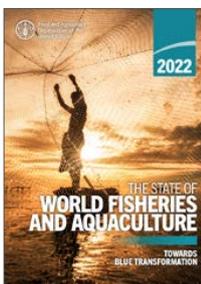


New publications



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Highlights



FAO 2022 The State of World Fisheries and Aquaculture 2022 - Rome

The 2022 edition of The State of World Fisheries and Aquaculture coincides with the launch of the Decade of Action to deliver the Global Goals, the United Nations Decade of Ocean Science for Sustainable Development and the United Nations Decade on Ecosystem Restoration. It presents how these and other equally important United Nations events, such as the International Year of Artisanal Fisheries and Aquaculture (IYFA 2022),

are being integrated and supported through Blue Transformation, a priority area of FAO's new Strategic Framework 2022–2031 designed to accelerate achievement of the 2030 Agenda for Sustainable Development in food and agriculture.

The concept of Blue Transformation emerged from the Thirty-fourth Session of the FAO Committee on Fisheries in February 2021, and in particular the Declaration for Sustainable Fisheries and Aquaculture, which was negotiated and endorsed by all FAO Members. The Declaration calls for support for “an evolving and positive vision for fisheries and aquaculture in the twenty first century, where the sector is fully recognized for its contribution to fighting poverty, hunger and malnutrition.” In this context, Part 1 of this edition of The State of World Fisheries and Aquaculture reviews the world status of fisheries and aquaculture, while Parts 2 and 3 are devoted to Blue Transformation and its pillars on intensifying and expanding aquaculture, improving fisheries management and innovating fisheries and aquaculture value chains. Blue Transformation emphasizes the need for forward-looking and bold actions to be launched or accelerated in coming years to achieve the objectives of the Declaration and in support of the 2030 Agenda. Part 4 covers current and high-impact emerging issues – COVID-19, climate change and gender equality – that require thorough consideration for transformative steps and preparedness to secure sustainable, efficient and equitable fisheries and aquaculture, and finally draws some outlook on future trends based on projections.

The State of World Fisheries and Aquaculture aims to provide objective, reliable and up-to-date information to a wide audience – policymakers, managers, scientists, stakeholders and indeed everyone interested in the fisheries and aquaculture sector.

[The PDF can be accessed directly at:](http://www.fao.org/3/cc0461en/cc0461en.pdf)
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FAO 2022 Report of the Eleventh Session of the Sub-Committee on Aquaculture. Rome, Italy, 24–27 May 2022 - Rome

The Eleventh Session of the Sub-Committee on Aquaculture of the FAO Committee on Fisheries was held virtually from 24 to 27 May 2022. This document presents the report of the Session reflecting the discussions which took place and containing the recommendations and guidance provided by the Sub-Committee. A synopsis of

the outcome of the Session is presented in the abstract and supplementary information is included in the appendixes.

[The PDF can be accessed directly at:](http://www.fao.org/3/cc0928t/cc0928t.pdf)
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FAO 2022 Committee on Fisheries: Report of the Eighteenth Session of the Sub-Committee on Fish Trade Committee on Fisheries - Rome

The Sub-Committee on Fish Trade was established by the Committee on Fisheries to serve as a multilateral consultation forum for discussions on the international trade of fisheries and aquaculture products. The 18th Session of the Sub-Committee was convened virtually from

8 April to 8 May 2022 and on 7, 8, 9, and 20 June 2022.

[The PDF can be accessed directly at:](http://www.fao.org/3/cc1513t/cc1513t.pdf)
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FAO 2022

Global Plan of Action for the Conservation, Sustainable Use and Development of Aquatic Genetic Resources for Food and Agriculture - Rome

This Global Plan of Action for the Conservation, Sustainable Use and Development of Aquatic Genetic Resources for Food and Agriculture (GPA) was developed by FAO at the request of the members of the Commission on Genetic Resources for Food and Agriculture in response

to the needs and challenges identified in the first global assessment of the status of Aquatic Genetic Resources for Food and Agriculture (AqGR). It was developed following broad consultation with the regions and, following endorsement by the Commission, was formally adopted by FAO members at the 168th session of the FAO Council. The GPA is voluntary and non-binding and aims to promote effective management of AqGR ensuring that it makes a significant contribution to food security and sustainable development and to the alleviation of poverty and is targeted at all stakeholders in aquaculture, with a focus on resource managers and policy makers. The GPA has two parts, the first part introduces and sets the context for the importance of AqGR to sustainable aquaculture and future food security. The second part identifies strategic priorities and recommends actions under four priority areas: i) characterization, inventory and monitoring; ii) conservation and sustainable use; iii) development of AqGR for aquaculture; and iv) policies, institutions, capacity building and cooperation.

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Fisheries and Aquaculture Technical Manuals



FAO 2022

Hatchery-based seed production of the Japanese scallop, *Mizuhopecten yessoensis* - Rome

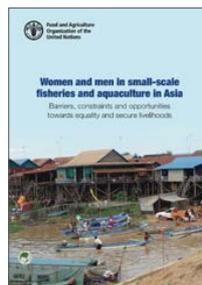
This guide is intended as a standalone practical manual for the culture of the Japanese or Yesso scallop, *Mizuhopecten yessoensis*. It is written for hatchery staff as a reference for daily operating procedures and for developing a site-specific and resource-specific seed production strategy.

To that end, the whole production cycle is addressed, from broodstock conditioning to transport of seed to the farm. It is the aquaculturist's decision as to whether all stages are required to achieve the target production in a given site and hatchery facility. Standard and more recent emerging techniques are included where possible, for the equal benefit of low and high technological operations. The manual starts with a brief overview of the anatomy and morphology of the scallop and describes the main organs of the adult specimen and the stages of its life cycle; the anticipated development time between each stage throughout its culture is added for the aquaculturist's benefit. This is followed by a chapter on the culture of live microalgae for food; different approaches to culturing large-scale microalgae are given, including traditional batch culture to the more recent newly designed photobioreactors. Protocols are given from stock to intermediate microalgal cultures for the inoculation of large-scale vessels. The integration of probiotic bacteria as an alternative to standard antimicrobial drugs is described in a separate chapter; this is a critical component of this manual as it is a current and important shift in sustaining optimal larval and spat performance. The need for biosecurity in a full cycle hatchery operation is emphasized and conceptually illustrated. The culture protocols for scallops start with the holding and conditioning of broodstock; assessments of the gametogenic stage, the manipulation of holding temperature to maintain and/or enhance gametogenesis and food requirements are all discussed to ensure the supply of broodstock for spawning when needed. Larval culture is one of the longest chapter of this manual and describes rearing in both static and flow-through systems with the expected growth and survival rate for the Japanese scallop. Post-larval culture in the nursery chapter is divided into early post-set up to Day-14, rearing of 1 mm spat and raising seed up to 5 mm or more in a land-based environment. The final chapter discusses different strategies affecting the time and size at which seed are transferred out of the nursery facility to either intermediate outdoor nurseries or to the farm sites.

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FAO Circulars



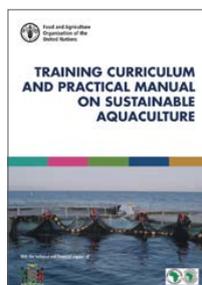
FAO 2022

Women and men in small-scale fisheries and aquaculture in Asia - Barriers, constraints and opportunities towards equality and secure livelihoods - Bangkok

Fisheries and aquaculture contribute to food security and livelihoods of millions of people in Asia. Both women and men are engaged in fisheries and aquaculture. In the past ten years, many actors have worked on raising awareness on women's contribution as well as promoting gender equality in fisheries and aquaculture. This study aims to consolidate the efforts to date to provide recommendations for action and future studies. Its objective is to answer the following questions for small-scale fisheries and aquaculture in Asia: (i) What is the division of labour between women and men in specific fisheries and aquaculture practices and what are the differences with respect to their access to assets, resources and entitlements? (ii) What are the drivers of such differences? (iii) What could be critical entry points and opportunities for addressing inequalities and discriminatory practices? To answer these questions, the study conducted an online literature search on gender and fisheries and aquaculture in Asia, selecting articles published between 2011 and 2021. This period was selected to understand the contemporary condition and state of knowledge, and since we aimed for an exhaustive list of literature, some limits in the time period was necessary. The review included both published peer-reviewed papers in journals as well as other research and project reports that are available online. In total, it reviewed 253 publications on fisheries and 210 publications on aquaculture. The top four countries where studies were conducted are India (44.3 percent of fisheries and 24.3 percent of aquaculture articles), the Philippines (35.6 percent of fisheries and 17.6 percent of aquaculture articles), Bangladesh (27.7 percent of fisheries and 32.9 percent of aquaculture articles) and Indonesia (30.8 percent of fisheries and 20.5 percent of aquaculture articles). The findings based on each research question are presented in this publication.

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FAO 2022

Training curriculum and practical manual on sustainable aquaculture - Rome

The Zambian Government, in collaboration with FAO, undertook the elaboration of this curriculum (part I) within the framework of the Zambia Aquaculture Enterprise Development Project (UTF/ZAM/077/ZAM). Furthermore, FAO complemented the practicality of this curriculum by drafting and refining the Training Manual (part II), which has been tested in many African countries and with different stakeholders. To ensure complementarity of opportunities and clear progression of education and capacity development, each actor involved in the sector should strive to network with teaching institutions, researchers and producers to guarantee that the curriculum remains relevant and stays abreast of developments for aquaculture practitioners; this will include developing national, regional and international linkages with institutions involved in aspects of training for aquaculture. Therefore, this curriculum will function as a living document.

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FAO 2022 Aquaculture sector situational analysis of Uzbekistan - Tashkent

Uzbekistan has abundant inland water resources, namely rivers and lakes, which are suitable for freshwater aquaculture. However, the production of fish is generally low compared to the resource potential due to the collapse of collectivized farms, a lack of interest in commercial operations and producer associations by local farmers, and the limited capacity of government extension and research facilities to promote fish production.

Growing interest by the Government in fish production has led to an increase in investment in the aquaculture sector. This has resulted in significant gains in fish production in recent years. Government land distribution schemes for smallholder fish farmers to establish individual fishponds to produce carp are a major contributing factor to these gains. There is no existing national fisheries or aquaculture sector specific development policy or plan, and reference to government policy towards the sector are through a number of existing presidential decrees. Given that the sector has witnessed a significant increase in fish production over recent years, addressing this issue (using other country fisheries policy and legislation as a potential model) was seen as an important first step for any coherent strategic plan for the sector. The report was compiled in 2020 as one of the outcomes of the TCP/UZB/3703 project focusing on national review and strategy for aquaculture sector and fish value chain in Uzbekistan. Due to the COVID-19 pandemic, this report was based solely on data sourced from the internet, academic papers and field data provided by the national consultant, including aquaculture value chain mapping and analysis of the project. The report includes a description of the Uzbekistan aquaculture sector, analyses its problems and opportunities, and presents options for its development.

The PDF can be accessed directly at:
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FAO 2022 A guide to recirculation aquaculture - An introduction to the new environmentally friendly and highly productive closed fish farming systems - Rome

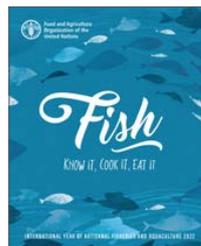
Stringent environmental restrictions to minimize pollution from hatcheries and land-based aquaculture facilities in northern European countries have sparked the rapid technological development, investment and innovation in recirculation systems in many parts of the world.

In general, aquaculture production affects the environment, but state-of-the-art recirculation methods reduce this effect considerably compared to traditional ways of farming fish. Recirculation systems thereby offer two immediate advantages: cost effectiveness and reduced environmental impact. Recirculation also secures a higher and more stable aquaculture production with less diseases and better ways to control the hatchery parameters that influence fish growth in aquaculture production systems. This development is welcome and fully in line with the FAO Code of Conduct for Responsible Fisheries. This guide focuses on the techniques for the conversion from traditional farming methods to recirculated aquaculture and advises the fish farmers on the pitfalls to be avoided along the way.

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Other FAO publications



FAO 2022 Fish: Know it, cook it, eat it - Rome

Fish may not suffice to ensure global food security, but there will be no global food security without fish: even as more than 800 million of us suffer from hunger, seafood products make up a fifth of the animal protein intake for nearly half of the world's population. To eat fish is to partake of one of our planet's most vital resources – and a chance to shift consumption patterns towards more sustainable agrifood systems.

Countless cuisines contribute to the gastronomic lore around fish and shellfish. From an Uzbek carp fry-up, dripping with garlic and herbs, to a Senegalese grouper thieboudienne, sharpened with sea snail; from an Indigenous Guyanese tuma pot, featuring the Amazonian tambaqui fish, to cured Dutch “Flag Day” herrings; from countries rich and poor, learn to cook and enjoy fish dishes across the traditions of 45 FAO Member States. In the process, get the lowdown on nutrition numbers; work out how to avoid fish fraud; learn about trade patterns, environmental concerns and ocean governance challenges; and glean scientific facts from a playful series of “fish interviews”.

Five celebrated chefs – two of them Michelin-starred – complete our offer, with dishes rooted in a drive for zero waste, respect for biodiversity and the pursuit of healthy diets.

The PDF can be accessed directly at:
www.fao.org/3/cc1395en/cc1395en.pdf

The document card can be found here:
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FAO 2022 The small-scale fisheries and aquaculture sector in Asia - Bangkok

This photostory book celebrates the International Year of Artisanal Fisheries and Aquaculture 2022 (IYAFA 2022) by showing the diversity of the small-scale fisheries and aquaculture sector in Asia, as home to the majority of the world's

small-scale fishers, fish farmers, fish workers. The photostory book pays homage to the many women and men at all stages of the small-scale fisheries and aquaculture value chain who are involved in capturing, harvesting, processing and trading. The photostory book introduces the International Year of Artisanal Fisheries and Aquaculture 2022 and shows how the celebration of IYAFA 2022 contributes to the achievement of the Sustainable Development Goals and provides an impetus towards the implementation of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication and the United Nations Decade on Family Farming.

The PDF can be accessed directly at:
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The document card can be found here:
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FAO 2022 Blue Transformation - FAO's work on aquatic food systems - Rome

Blue Transformation outlines a vision to expand aquatic food systems and increase their contribution to nutritious and affordable healthy diets for the most vulnerable, while fostering equitable growth, especially for those

communities that depend on fisheries and aquaculture. This vision is aligned with the 2021 Declaration for Sustainable Fisheries and Aquaculture of the Committee on Fisheries (COFI) of the Food and Agriculture Organization of the United Nations (FAO) and FAO's Strategic Framework 2022–2031.

Blue Transformation recognizes the importance of aquatic food systems as drivers of employment, economic growth, social development and environmental recovery, which all underpin the SDGs. It also recognizes the need to support the 2030 Agenda through the transformation to more efficient, inclusive, resilient and sustainable aquatic food systems for better production, better nutrition, better environment, and better life, leaving no one behind.

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The document card can be found here:
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FAO 2022 Promoting sustainable aquaculture for food security and economic development - Harare

In the Southern African Development Community (SADC) Region, it is estimated that around 100 million people eat fish and other aquatic foods (molluscs, crustacea) regularly. Aquatic foods are generally the most affordable source of dietary animal protein containing essential fatty acids and micronutrients, and are therefore of

overwhelming importance for food and nutrition security, particularly for poorer segments of the population, and for sustaining livelihoods and driving economic development. However, per capita consumption of aquatic foods in SADC (2015) at 11.3 kg/yr is 79 percent lower than the global average of 20.2 kg/yr; moreover, the high consumption rates in some of the island and coastal states mask the very low consumption rates of around 5 kg/capita/yr in the rest of the region. With rapid population growth, the gap between supply and demand of aquatic foods in most SADC countries continues to increase. Taking only fish into account, it is predicted that SADC Member States will collectively have a supply deficit by the mid-2020s of around 570 000 MT per year.

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FAO 2022 Defining and implementing a tilapia welfare assessment protocol in Brazil - Bangkok

Although welfare protocols for fish have been developed in the past, indicators are species specific and peer-reviewed journals do not contain any tilapia welfare protocol assessments. The new tilapia welfare assessment protocol was disaggregated into four aspects: health, environment, behaviour and nutrition. If any

problem regarding any of these aspects is found, actions need to be taken to improve it, resulting in better welfare. The researchers behind a practical welfare assessment protocol for tilapia production in Brazil hope it can act as a framework for the implementation of a welfare management system that can be applied by tilapia farmers around the world. The same framework is currently being applied in China and Thailand, while protocols and standards for shrimp and carp are also being developed.

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The document card can be found here:
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FAO 2022 The rediscovered potential of seaweed dietary additives - Rome

The cellular structure of seaweeds comprises indigestible fibres or complex polysaccharides, which are used as thickening additives or gelling agents in a range of processed foods and in cosmetics, pharmaceuticals, nutraceuticals and other industries. To date, only a handful of seaweed species have been used commercially as animal feed additives. Two main reasons

underpin the use of seaweeds as dietary additives are to bolster the immune system of farmed animals and to improve their productivity and meat quality. Southeast Asia could play a significant role in the production of tropical seaweeds for animal feeds. Due to the vast number of seaweed species, novel seaweed additives, with the potential for animal production, are being discovered.

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The document card can be found here:
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FAO 2022 Gene editing in aquaculture - Bangkok

The document is a brief of a specific aquaculture innovation. It contains information on the technique and approach used, scope and scale of application, accessibility and the outcome and benefits of the innovation.

Gene editing holds significant potential to enhance selective breeding. While selective breeding has been successful, it is limited by the heritability of the trait. Gene editing also prevents

interbreeding with wild fish should they escape from a farm and offers the potential for improved growth rates. Current studies into gene-editing cover a wide range of aquatic species – including various salmonids, rohu, grass carp, common carp, channel catfish, Pacific cupped oyster, Nile tilapia and red seabream. However, the regulatory hurdles and the issues of cost and ethical concerns remain the constraints for upscaling.

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FAO 2022 Aquaculture's next frontier? - Bangkok

The document is a brief of showcase of a specific aquaculture innovation. It contains main information on the technique and approach used, scope and scale of application, accessibility and the outcome and benefits of the innovation.

Aquaculture has traditionally been carried out in freshwater and coastal areas. This causes pressures including competition for space from other activities, issues with disease and poor

water quality and runoff carrying nutrients and pollution from other land-based activities. Increasing numbers of companies and research institutes are looking to develop new technologies for offshore systems. Investment from the salmon sector is likely to accelerate the adoption of offshore technology for producing other species. While capital investment costs are likely to be higher for offshore aquaculture systems, operational costs have been predicted to decrease over time. Offshore systems are likely to offer one means of increasing aquatic food production and potentially easing pressure on waterways and inshore coastal areas.

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The document card can be found here:
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FAO 2022 The growth of single-cell protein in aquafeed - Bangkok

This review describes the use of feedstock yeasts and bacteria for aquaculture feed, with an emphasis on those sourced from carbon dioxide, ethanol and brewery by-products for their comparatively low costs and sustainability credentials. The scope of application of single-cell protein based feeds and their outcome, are benefits are presented. Aquaculture competes with fish meal use in the diets of swine, poultry

and pets, and fish meal production cannot match the growth of all of these industries without jeopardizing forage fish stocks. While fish meal has been partially replaced with ingredients from soy, this has raised environmental sustainability and fish welfare questions. A number of companies have emerged in the alternative protein sector including producers of proteins from single-cell organisms such as bacteria, yeast and microalgae. Proteins made from single-cell organisms are being produced in growing quantities for aquafeeds. Currently, there are aquafeed producers in Asia, Europe and North America lead this field. A considerable reduction in price and increase in volume will be required before single-cell proteins are widely used by aquafeed producers and aquatic farmers.

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Calendar of events

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JANUARY 2023

Guidelines for Sustainable Aquaculture Task Force meeting.

Virtual, 9–11 January 2023

Information: GSA@fao.org

MARCH 2023

12th Session of the COFI Sub-Committee on Aquaculture

Ciudad Obregón, 7–10 March 2023

Information: COFI-Aquaculture@fao.org

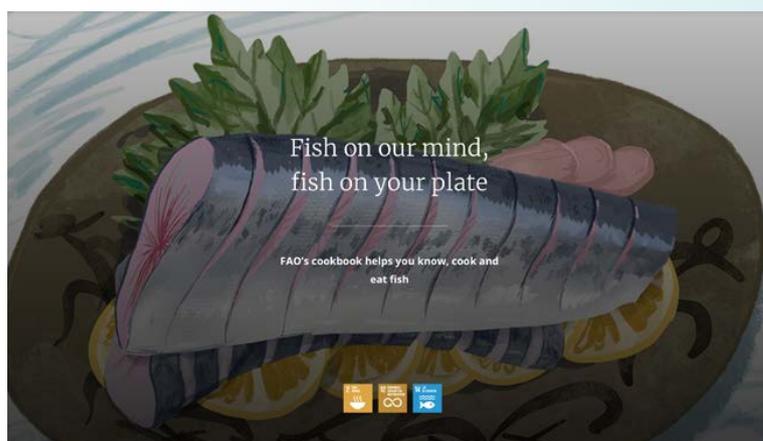


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Workers selecting tilapia broodstock, Côte d'Ivoire.

Raising the visibility of aquaculture through FAO STORIES

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



FISH ON OUR MIND, FISH ON YOUR PLATE FAO's cookbook helps you know, cook and eat fish

FAO's Fish: **Know it, cook it**, eat it presents traditional recipes from dozens of countries and features dishes from celebrated chefs. But it also takes the reader on a journey to learn a whole lot more about fish and shellfish culture, science and trade. It additionally helps consumers recognize various types of fish, their origin and nutritional value. With its spectacular illustrations, interesting food facts, humorous fish "interviews" and tantalizing recipes, it is unlike any other fish recipe book.

Read the FAO Story here:

<https://www.fao.org/fao-stories/article/en/c/1609482/>

BRINGING WATER LILIES BACK INTO NATURE AND BACK TO SENEGALESE KITCHENS

FAO is boosting biodiversity to ensure healthier ecosystems and healthier diets

Grown in natural wetlands by the local community, water lilies are organically farmed without the use of fertilisers or pesticides. Their seeds can be used in many dishes, such as thieboudienne, or made into a nutritious flour, used to prepare fritters, small cakes or delicious pancakes. In this story, see how Maia Diagne and her community are working to revive the traditional cultivation of white water lilies with the help of the FAO-led RESSOURCE Project, the Sahelian wetlands site of the Sustainable Wildlife Management Programme.

Read the FAO Story here:

www.fao.org/fao-stories/article/en/c/1618552/



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



Blue Transformation is the vision and the process by which FAO, its Members and partners can use existing and emerging knowledge, tools and practices to secure and maximize the contribution of aquatic (both marine and inland) food systems to food security, nutrition and affordable healthy diets for all.

BLUE TRANSFORMATION

Roadmap 2022–2030

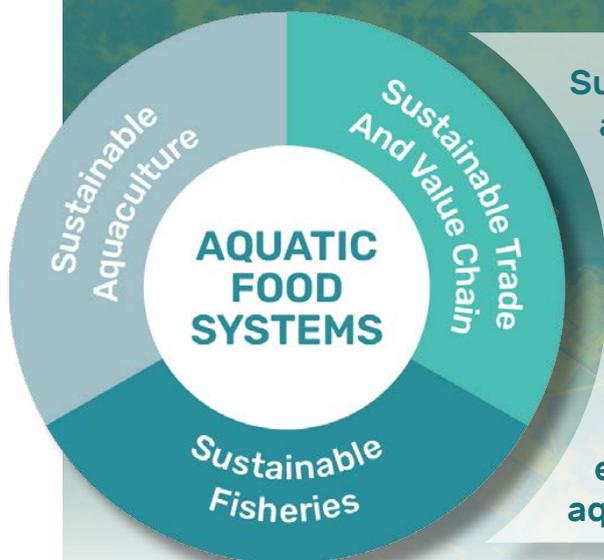
A vision for FAO's work on aquatic food systems

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.



Read more here: www.fao.org/3/cc0459en/cc0459en.pdf

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