



31st NACA Governing Council held online



The 31st Governing Council Meeting (GCM) of NACA was held from 29-30 November via video conference. The meeting was attended by 44 participants including the representatives of 16 member governments, the Regional Lead Centres for China, India, Iran and Thailand, the Food and Agriculture Organization of the United Nations (FAO), the Asia-Pacific Association of Agricultural Research Institutions (APAARI), the Network of Aquaculture Centres in Central and Eastern Europe (NACEE), the Pacific Community (SPC), the Bangladesh Shrimp and Fish Foundation (BSFF) and the Centre for Integrated Rural Development for Asia and the Pacific (CIRDAP). Hong Kong SAR was selected as Chair of the 31st Council and Thailand the Vice chair.

The main agenda item for the meeting was consideration of the new NACA Strategic Plan 2021-2024. The plan is a reworking and expansion of NACA's programmes to reflect the current operating environment, which has changed significantly in the advent of the pandemic, under the theme "Networking Regional Resources for Sustainable Aquaculture". The new programme structure is as follows:

- Productivity and Sustainability.
- Health and Biosecurity.

- Genetics and Biodiversity.
- Safety and Quality.
- Emerging Regional and Global Issues.
- Education and Training.
- Information and Networking.
- Strategy and Governance.
- One Community.

Implementation of the programmes will be via formation of subnetworks of experts or communities of practice, to share experience, resources, and opportunities, develop and take part in collaborative projects. The approach will initially be piloted on a few priority programmes and scaled up as resources permit.

The new strategic plan emphasises the use of virtual networking, with the majority of NACA workshops and events to be held online. This will continue the practice that has been proven over the past two years, as the pandemic has driven widespread adoption of virtual networking and normalised

online collaboration. NACA's experience has been that a virtual event attracts from five to ten times as many participants, due to removal of travel and cost constraints, compared to an equivalent physical meeting and at a fraction of the cost. Video conferencing also eases the recording of presentations, which can then be shared via YouTube and similar platforms, further increasing reach of technical content.

The new strategic plan will be published on the NACA website in due course.

Of the issues raised by members, common issues included a renewed interest in the expansion of mariculture including in deep sea sites, the integration of "internet of things" technologies and automation in aquaculture systems, aquatic animal health and biosecurity and climate change impacts and mitigation.

The GCM considered a briefing on the outcomes of the Global Conference on Aquaculture Millennium +20, which had been the flagship event for 2021. FAO thanked the government of China for hosting the conference, which had been attended by 1,728 people from 113 countries, of which 1,228 attended virtually. Preparations for the conference included the development of a series of regional reviews on the status of aquaculture development and a series of thematic review papers, which were prepared by teams of expert authors commissioned by FAO and opened for public comment.

The main output of the conference, the Shanghai Declaration, was unanimously adopted by the participants and over 40 organisations had provided written statements of support, which are available on the conference website (<https://aquaculture2020.org>). It was noted that the Shanghai Declaration was a participant's declaration, outlined by an invited group of experts, informed by regional and thematic reviews and with input from many stakeholders of diverse interests.

SDG-aligned *Artemia* Aquaculture Workshop held in China / online

With the expansion of hatchery production, the demand for *Artemia* cysts has continued to increase. Annual consumption is now estimated at 3,500 – 4,000 tonnes, underpinning the production of over 900 billion crustacean post larvae and fish fry by a hatchery industry valued at more than USD 2 billion, and the final production of over 10 million tonnes of high-value aquaculture species. With approximately 90 percent of the current *Artemia* production harvested from inland salt lakes, the future of the hatchery industry could be at risk and requires urgent attention.

A new international interdisciplinary approach is needed to tackle these *Artemia* issues and opportunities, like the breakthrough in *Artemia* use in aquaculture following the 1976 FAO Kyoto conference. The purpose of the workshop was to explore needs and opportunities for a new international initiative to guarantee a more sustainable provision of *Artemia*, both from natural sources and from controlled extractive *Artemia* farming integrated with salt production and other fish/crustacean aquaculture.

The workshop was held on 22 September in conjunction with the Global Conference on Aquaculture Millennium +20 in Shanghai, China with international participation via video conference. The programme included technical presentations and a Q&A session with participants and an expert discussion panel. Over 400 people participated in the workshop, both locally in China and via video conference. The workshop was organised by:

- Food and Agriculture Organization of the United Nations.
- Laboratory of Aquaculture and Artemia Reference Center, Ghent University.
- Network of Aquaculture Centres in Asia-Pacific.
- Artemia Association of China.
- Asian Regional Artemia Reference Center.

Presentations

The presentations from the workshop are summarised below, but video recordings are also available for viewing via YouTube at:

- <https://www.youtube.com/playlist?list=PLZxXgR0J17z0MeAdFe9P7qzc8PFRjIXyr>

Patrick Sorgeloos (Ghent University)

made a presentation "From Kyoto 1976 to Shanghai 2021: Brief history of *Artemia* use in Aquaculture". He described the key life cycle traits of *Artemia* and its crucial role in the commercial hatchery production of fish and crustacean species, beginning with the first commercial sources of *Artemia* cysts in the 1960s, and the first concerns about *Artemia* as a potential bottleneck at the FAO Technical Conference on Aquaculture in 1976. FAO had supported early work to verify the characteristics of *Artemia* and to investigate the feasibility of inoculating salt flats for integrated salt-*Artemia* production. In 1978 the Artemia Reference Center was established at Ghent University upon the suggestion of FAO. The International Study on Artemia was launched as an interdisciplinary study of *Artemia* strains, producing over 50 papers on aspects of the biology of *Artemia* and its application in aquaculture, culminating in the publication of the Manual for the Culture and Use of brine Shrimp Artemia in Aquaculture in 1986 (the "Artemia Manual"), and a chapter on *Artemia* in the FAO Manual on the Production and Use of Live Food for Aquaculture in 1996. Over time *Artemia* has come to underpin a significant fraction of commercial hatchery production for the aquaculture industry. Localised production provided security for local aquaculture industries. Concerns regarding the *Artemia* resource include sustainable harvesting, the protection of habitats, and preservation of the gene pool. The International Artemia Aquaculture Consortium has been established to address these concerns and to expand sustainable use of *Artemia* in aquaculture, involving 28 different countries.

Meezanur Rahman (WorldFish Centre) and Nguyen Van Hoa (Can Tho University) gave a Report of the 15 June 2021 webinar "International Workshop on *Artemia* Pond Production". The Artemia4Bangladesh project aimed to enhance food and nutrition security in Bangladesh through climate smart innovation, including introduction of integrated salt-*Artemia* systems and increased productivity in marine aquaculture in Cox's Bazar. The purpose of the workshop was to share information between public, private and academic stakeholders and to promote *Artemia* culture and research in different countries. More than 70 participants from 14 countries attended. Presentations gave an overview of farmed *Artemia* biomass and cyst production practices in different countries including Vietnam, India, Iran, Kenya, Cambodia, Myanmar, Bangladesh, China, Thailand, and Malaysia. Recommendations included integrating *Artemia* artisanal salt farming in Asia and Africa, desert/arid and salt-affected areas, conducting more work on species / strain selection and improvement for aquaculture applications, improving the resilience of *Artemia* pond culture to climate change events, and selecting suitable agricultural by-products as a food source for *Artemia*.

Simon Wilkinson (Network of Aquaculture Centres in Asia-Pacific) gave a report of the 2 September 2021 webinar "Status of the Use of *Artemia* Cysts in Fish and Crustacean Hatcheries Around the World", which was attended by 359 people from 53 countries and facilitated by the International Artemia Aquaculture Consortium. The workshop had featured presentations on contemporary hatchery practices from around the globe, which were described. The presentations revealed a wide diversity in hatchery practices, variations in efficiency and many deviations from the standardised protocols of the Artemia Manual. Allowing *Artemia* development to progress to instar II posed a biosecurity risk, as nauplii become contaminated by *Vibrio* and other potentially pathogenic bacteria once they begin to feed. The application of the umbrella stage of a particularly small *Artemia* strain (Vin Chau salt ponds) in mud crab hatchery production was highlighted. It was clear that there were significant opportunities to improve both *Artemia* utilisation and production. It was timely to reconsider publication of good aquaculture practices and standardised protocols for *Artemia* production and use in hatcheries, with a view to improving both the efficiency of cyst use and the biosecurity of *Artemia* as feed. The webinar recommended updating the FAO Artemia Manual and convening localised training courses for hatchery staff to facilitate uptake of good practices. The presentations from this workshop are available separately on YouTube at:

<https://www.youtube.com/playlist?list=PLZxXgR0J17z3oahrQdjZw1S6602KifbUa>

Thomas Bosteels (Great Salt Lake Brine Shrimp Cooperative) gave a presentation Sustainable harvesting of natural *Artemia* resource: the Great Salt Lake (Utah, USA) as model case. Around 90% of *Artemia* was still harvested from natural resources, highlighting the importance for sustainable management of wild *Artemia* and their salt lake habitats. Salt lakes were sensitive environments and vulnerable to anthropogenic influences. The progressive development of management measures for the Great Salt Lake and its *Artemia* resources was described. Salinity and nutrient management were the two main drivers for *Artemia* population health, with the optimum salinity range being 120-160 g/L to avoid predation and physiological issues, and adequate

nutrient loading to support the population, as the lake is primarily nitrogen limited, with a co-limitation of phosphorus. A causeway allows adaptive management of the flow and salinity within the south arm of the lake which is the primary *Artemia* resource. Water inflows are regulated by government agencies at both State and Federal level, with input from the Great Salt Lake Advisory Council, a cooperative process involving stakeholders from many sectors.

Gonzalo Gajardo (Los Lagos University) gave a presentation "*Artemia* species and strains diversity: threats and potential". Wild genetic resources included six regional sexual species and asexual types. Genetic diversity in key traits were often harboured in locally adapted populations. Incipient farmed types with useful characteristics such as improved thermal tolerance had emerged following translocation of *Artemia* to new sites. There was a need for systematic monitoring of genetic diversity to assess impacts of climate change, habitat loss and other adverse factors. Loss of intraspecific genetic diversity was a hidden biodiversity crisis. *Artemia* provided an excellent model to study genotype-environment interactions for key aquaculture or adaptive traits.

Gilbert Van Stappen (Ghent University) gave a presentation "Availability of *Artemia* genome: R&D opportunities". The majority (90%) of the *Artemia* genome had recently been published and was now available through the ORCAE platform (for access contact Prof. Peter Bossier, Laboratory of Aquaculture and Artemia Reference Center, Ghent University, peter.bossier@ugent.be). This data had considerable potential to assist with characterisation of *Artemia* strains and to inform selective breeding programmes. A gene for salt tolerance had been found (De Vos et al. 2021, The genome of the extremophile *Artemia* provides insights into strategies to cope with extreme environments, BMC Genomics Vol. 22, Art. 635), and *Artemia* was expected to provide a new model organism for gene discovery.

Q&A / panel discussion

A question-and-answer session was held with panellists providing feedback on questions from participants:

- Regarding biosecurity measures in *Artemia* production, biosecurity starts with protection of the resource, for example not allowing aquaculture within catchments used for natural cyst production. Hyper-saline conditions were beneficial in excluding potential hosts from the environment. With good disinfection procedures during processing, it was possible to produce cysts that did not contain human or aquaculture pathogens. However, pathogens could enter during the hatching process in the hatchery, if care was not taken to maintain good conditions.
- Many parthenogenetic *Artemia* strains occurred in China, it was likely that there would be some differences between them, but it was necessary to test different strains in order to document their characteristics.
- Africa had considerable potential for *Artemia* production, but wild populations were little studied and commercial developments were limited at present.

- *Artemia* availability was unlikely to become a constraint to future aquaculture development, assuming the ongoing trend of improving utilisation efficiency continued, and given the high potential for investments in *Artemia* research to deliver improved strains or farmed *Artemia* as a supplement to wild sources.
- Develop science-based protocols to assure sustainable harvesting of wild *Artemia* sources, especially in central Asia.

Conclusion and recommendations

The workshop made the following specific recommendations:

- Develop improved guidelines for bio-secure production and use of *Artemia* in hatcheries, including an update of the FAO *Artemia* manual and convene regional *Artemia* training courses for local hatcheries, to disseminate good practices and facilitate adoption of standardised protocols.
- In view of the large variety of species and strains of *Artemia* that are now available in the market their specific characteristics should be studied to identify their most suitable application for specific species of fish and crustaceans. This could relate to their nutritional composition, synchrony in hatching or enrichment characteristics.
- Initiate strain selection and selective breeding to develop improved *Artemia* strains for aquaculture applications, noting the availability of the *Artemia* genome.
- Investigate the use of umbrella *Artemia* as successfully applied in the Vietnamese crab hatcheries for wider application in aquaculture, as a new source of live food in earlier larval stages, be it for shrimp or in fish.
- Reconsider a wider use of *Artemia* enrichment techniques in hatcheries, as it is now restricted to applications in marine fish and crab production. This method not only allows enhancement of the nutritional value of the nauplii but can also be used as a vector to deliver, for example pre- or probiotics to the larvae.
- Investigate the impact of climate change on *Artemia* production in inland lakes and coastal saltworks.
- Conserve *Artemia* biodiversity through means such as a cyst banks, species identification, “wild” vs “farmed” species, genotyping and strain characterisation.
- Investigate integration of extractive *Artemia* farming with intensive fish/crustacean aquaculture.
- Investigate the use of *Artemia* biomass as high value protein ingredient in human diets.
- Consider integration of *Artemia* production in artisanal salt farming in Asia and Africa, desert/arid and salt-affected areas.

Closing remarks

The closing remarks were given by Matthias Halwart, FAO. He recounted the hypothesis of Patrick Sorgeloos at the 1976 FAO Technical Conference on Aquaculture in Kyoto, concerning the potential for *Artemia* to play a role in aquaculture, which FAO assisted in verifying, leading to *Artemia* becoming a widely accessible and suitable live food for fish and shrimp hatchery developments that were just taking off at that time. Over subsequent decades improvements in *Artemia* availability, sources and optimisations in utilisation had contributed to continued expansion of the fish and crustacean aquaculture. He noted that FAO had undertaken to prepare an updated *Artemia* manual to ensure more sustainable and bio secure use of this important food source. He noted the workshop’s advice to invest more in the study of *Artemia* biodiversity, sustainable exploitation, and management of salt lake resources in a changing climate, and the parallel need to explore farmed production of *Artemia*. He indicated that FAO’s Sub-Committee on Aquaculture would be informed of the progress highlighted by the workshop for member countries to consider further work on *Artemia*.

Policy brief on sustaining the future of the global seaweed industry

A policy brief on “Ensuring the Sustainable Future of the Rapidly Expanding Global Seaweed Aquaculture Industry – A Vision” authored by 37 experts from 30 organisations worldwide was published by the UNU Institute on Comparative Regional Integration Studies on 10 November 2021. The policy brief highlighted the key challenges that must be addressed for the long-term sustainability of the global seaweed industry, ensuring its role in providing nature-based solutions within the sustainable ocean economy agenda and contributing to the UN Decade of Ocean Science for Sustainable Development (2021 – 2030).

The policy brief acknowledges that seaweed production has increased 15 fold over the past 50 years. The industry produces an equivalent to about 35 million tonnes fresh weight, about 51% of the world’s mariculture production, with a total value estimated at USD 14.7 billion. The seaweed value chain supports the livelihoods of about 6 million small-scale farmers and processors. NACA member states such as China, Indonesia, the Philippines, and Malaysia produce the majority of farmed seaweeds in the world. Farmed seaweed is used in food, food supplements, feed, fertilisers, and biostimulants, as well as substitutes for fossil fuels and their derivatives. Moreover, seaweed farming benefits restore degraded environments, enriches biodiversity, and has

potential to contribute to mitigation of the effects of climate change and coastal acidification. The seaweed industry has broad potential to address the UN SDGs.

The policy brief warns that the global seaweed industry faces significant challenges for future development. Socio-economically, a pest or disease outbreak can have devastating economic consequences on farmers, families, and their wider communities. The policy brief provided recommendations to balance economic profitability with the environment, human needs and health. The policy brief emphasised the sustainable seaweed industry requires effective biosecurity and genetic diversity from its analysis. It indicated that the introduction and spread of seaweed pests and disease poses a major and increasing threat to production. The movement of live seaweeds is acknowledged as a major vector. Introduced non-indigenous macroalgae can also alter ecosystem structure and function. As the global seaweed aquaculture industry grows and diversifies, the risk of introducing known and emerging pests and diseases to the new regions will escalate. National dependence on introduced seaweeds and their cultivars from other countries and regions, whenever possible, should be reduced.


The report makes policy recommendations for promoting wider environmental, gender-responsive and socially inclusive approaches to upscaling the seaweed industry, which includes:

- Developing clear international seaweed-related policies and regulations to improve biosecurity and genetic diversity.
- Developing global, regional, and national technology transfer and capacity building initiatives, focusing on biosecurity and genetic diversity.
- Developing regional and national seed stocks and biosecure nurseries.
- Maintaining the genetic diversity in wild stocks.
- Further developing assessment tools for balancing environmental and economic risks with the potential benefits of seaweed production.
- Incentivising the integration of seaweed production with other extractive and fed-aquaculture species and maritime activities.
- Channeling support for long-term investments to promote the beneficial aspects of the industry.
- Establishing international seaweed research networks to conduct further innovative, interdisciplinary research spanning the natural and social sciences.


The policy brief team was led by Prof. Elizabeth J. Cottier-Cook from Scottish Association for Marine Science, UNU Associated Institution, Scottish Marine Institute. Eight organisations from six NACA member states and the Secretariat were involved in the policy brief team.

The policy brief is available download from:

<https://cris.unu.edu/gsstarpolicybrief>



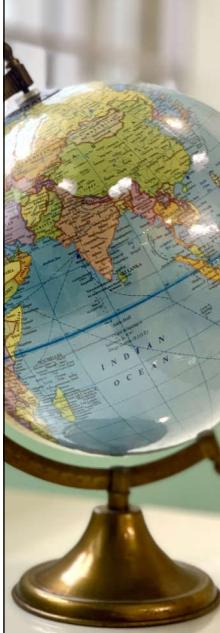
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POLICY BRIEF
#06 2021

Ensuring the Sustainable Future of the Rapidly Expanding Global Seaweed Aquaculture Industry - A Vision



Highlights

1. This policy brief highlights key challenges that must be addressed for the long-term sustainability of the global seaweed industry, ensuring its role in providing nature-based solutions within the sustainable ocean economy agenda and in contributing to the UN Decade of Ocean Science for Sustainable Development (2021 - 2030).
2. Seaweed production has grown rapidly over the past 50 years. It currently accounts for over 50 % of total global marine production, equating to ~35 million tonnes. In 2019, the industry's total value was estimated at USD 14.7 billion. The seaweed value chain supports the livelihoods of approximately 6 million small-scale farmers and processors, both men and women, many of whom live in coastal communities in low- and middle-income countries.
3. The aquaculture sector is increasingly interested in seaweed because of its potential for greater use in food, food supplements, animal feed, fertiliser and biostimulants, and in alternatives to fossil fuels and their derived products, such as plastics. Its cultivation can help restore degraded environments, increase ocean biodiversity and mitigate the effects of climate change and coastal acidification by capturing carbon and other nutrients. In low-, middle- and high-income countries, the seaweed industry has a wide-ranging potential to address the UN Sustainable Development Goals (SDGs) in particular, SDG 14 (life below water), SDG13 (climate action), SDG6 (decent work and economic growth) and SDG5 (gender equality).
4. The global seaweed industry, however, faces significant challenges. For future sustainability, improvements are urgently needed in biosecurity and traceability, pest and disease identification and outbreak reporting, risk analysis to prevent transboundary spread, the establishment of high quality, disease-free seed-banks and nurseries and the conservation of genetic diversity in wild stocks.
5. These improvements require technological innovation, capacity building and effective gender-responsive and co-ordinated policies, incentives and regulations. They will need to enhance occupational safety, whilst increasing the industry's resilience to the impacts of climate change and production hazards, such as pest and disease outbreaks. To align with the SDGs, particular attentions will need to be paid to small scale farmers and processors to ensure that the globalisation of seaweed aquaculture supports the development of sustainable, resilient and inclusive livelihoods.

Quarterly Aquatic Animal Disease Report

The Quarterly Aquatic Animal Disease report provides information about the status of aquatic animal disease in 21 participating states in the Asia-Pacific region. The diseases covered in the report are reviewed annually by the Asia Regional Advisory Group on Aquatic Animal Health.

The report was first published in the second quarter of 1998. It is a joint activity between NACA, the Food and Agriculture Organization of the United Nations (FAO) and the World Organization for Animal Health (OIE) Regional Representation in Tokyo.

The most recent reports are now being offered as Excel spreadsheets, rather than PDF, while an electronic reporting system is developed. The files may be downloaded from:

<https://enaca.org/?id=8>

Training Course on Mariculture Technology in Asia-Pacific



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NACA is a network composed of
19 member governments in the
Asia-Pacific Region.



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A free online training course on mariculture technologies was hosted by the Yellow Sea Fisheries Research Institute (YSFRI), from 18 October to 5 November, organised by the Department of International Cooperation, Ministry of Science and Technology, People's Republic of China.

The course was aimed towards officials, researchers and technician from fisheries and aquaculture departments, research institutions and enterprises, with priority given to personnel from developing countries.

308 people participated in the training from 28 countries, with those completing the training receiving a certificate from the Ministry.

The training was delivered by video conferencing, with the training covering subjects including:

- Genetics and breeding of mariculture species.
- Large-scale propagation techniques.
- Disease control and prevention.
- Nutrition research and feed development.
- Technology for different farming models.
- Equipment research, engineering and construction of farming facilities.

- Quality and safety inspection technology for aquatic projects.

Technical presentations from the course were recorded and will be shared on NACA's YouTube channel in due course. The link will be announced in a future edition of the newsletter.

YSFRI, founded in January 1947, is the oldest multidisciplinary research institute of marine fisheries in China. With an enduring dedication to the pursuit of academic excellence for nearly 70 years, YSFRI has made contributions in many fields of mariculture.

To date, the institute has established artificial propagation and culture techniques for more than 30 commercially important marine species, developed sixteen new varieties for mariculture, and set up and optimised several mariculture models such as integrated multi-trophic aquaculture for coastal aquaculture and pond culture, land-based industrialised mariculture, offshore net cage culture and sea ranching.

The institute has developed rapid on-field detection kits for over twenty aquatic pathogens, established and optimised several deep processing techniques for aquatic products and developed testing methods and inspection technologies for aquatic products safety and quality.

At present, YSFRI has ten research divisions, three experimental bases and four research vessels equipped with state of the art facilities to carry out fisheries research. The institute has over 400 faculty and staff members, including 160 senior scientists. Currently YSFRI's postdoctoral program offers research opportunities for more than 30 postdoctoral scholars.

This was the fourth online training course offered by YSFRI and the third mariculture training course. NACA would like to thank YSFRI and the Ministry of Science of Technology for their kind support in organising the training, and in making placements available to personnel from NACA member states and elsewhere.