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AQUACULTURE FOR FOOD AND SUSTAINABLE DEVELOPMENT**

Shanghai, China, 22–25 September 2021

Report of the
Global Conference on Aquaculture Millennium +20
Aquaculture for food and sustainable development
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PREPARATION OF THIS DOCUMENT

This is the final report of the Global Conference on Aquaculture Millennium +20 – Aquaculture for food and sustainable development, which was held in Shanghai, the People’s Republic of China, from 22 to 25 September 2021.

ABSTRACT

Feeding an expected global population of 9 billion by 2050 is a daunting challenge that is engaging hundreds of millions of farmers, food processors, traders, researchers, technical experts, and leaders the world over. Fish and other aquatic products from aquaculture can and will play a major role in meeting the dietary demands of all people, while also meeting the food security needs of the poorest.

To realize the maximum contributions of the aquaculture sector toward achieving the targets set by the Sustainable Development Goals (SDGs) and Agenda 2030, coordinated and accelerated actions are required. Not only must these actions increase sustainable production, but also address the broader value chain, markets, and decent employment.

Recognizing the critical importance of aquaculture, and the need to exchange and discuss reliable information to further enhance its contribution to sustainable development, the Food and Agriculture Organization of the United Nations (FAO), at the request of its Members, collaborated with the Network of Aquaculture Centres in Asia-Pacific and the Ministry of Agriculture and Rural Affairs of the People's Republic of China, to organize the Global Conference on Aquaculture Millennium +20 (GCA +20), 22–25 September 2021, in Shanghai, the People's Republic of China.

Under the theme “Aquaculture for food and sustainable development”, the GCA +20 aimed to bring stakeholders from government, business, academia, and civil society together to identify the policy and technology innovations, investment opportunities and fruitful areas of cooperation in aquaculture for food and sustainable development. A key output from the GCA +20 – the *Shanghai Declaration on Aquaculture for Food and Sustainable Development* – highlights the principles and strategic pathways to maximize sustainable aquaculture in achieving the SDGs, with a special focus on “Leaving no one behind”.

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Abbreviations and acronyms

AqGR	aquatic genetic resources
CAFS	Chinese Academy of Fishery Sciences
CAPPMA	China Aquatic Products Processing and Marketing Alliance
CCRF	Code of Conduct for Responsible Fisheries
COFI	Committee on Fisheries
COVID-19	coronavirus disease
CSF	China Society of Fisheries
EAA	Ecosystem Approach to Aquaculture
FAO	Food and Agriculture Organization of the United Nations
FDI	foreign direct investment
GCA +20	Global Conference on Aquaculture Millennium +20
GIFT	Genetically Improved Farmed Tilapia
IMTA	integrated multitrophic aquaculture
IOC	International Organizing Committee
IPC	International Programme Committee
LAC	Latin America and the Caribbean
LOC	Local Organizing Committee
MARA	Ministry of Agriculture and Rural Affairs of China
Mt	metric tonnes
NACA	Network of Aquaculture Centres in Asia-Pacific
NENA	Near East and North Africa
NGO	non-governmental organization
RAS	recirculating aquaculture system
R&D	research and development
SDG	Sustainable Development Goal
SHOU	Shanghai Ocean University
SIDS	small island developing states
SMEs	small and medium enterprises
WFT	World Fisheries Trust

PART I: INTRODUCTION

Background

1. Farmed fish and plants have long contributed to healthy diets, poverty alleviation and rural development. It is only recently, however, that aquaculture has grown to be the world's leading source of aquatic food, which is expected to meet expanding global dietary demands while also addressing the food security needs of the poor.
2. Feeding an expected global population of 9 billion by 2050 is a daunting challenge that is engaging hundreds of millions of farmers, food processors, traders, researchers, technical experts, and leaders the world over. Fish and other aquatic products from aquaculture can and will play a major role in meeting the dietary demands of all people, while also meeting the food security needs of the poorest.
3. To realize the maximum contributions of the aquaculture sector toward achieving the targets set by the 2030 Agenda and the SDGs, coordinated and accelerated actions are required. Not only must these actions increase sustainable production, but also address the broader value chain, markets, and decent employment.
4. Recognizing the critical importance of aquaculture, and the need to exchange and discuss reliable information to further enhance its contribution to sustainable development, FAO was requested by the Thirty-third Session of the Committee on Fisheries (COFI) to collaborate with the Network of Aquaculture Centres in Asia-Pacific (NACA) with preparations for a Global Conference on Aquaculture Millennium +20 (GCA +20), as was done previously in 2000 and 2010. The Tenth Session of the COFI Sub-Committee on Aquaculture welcomed and supported the proposal of China to host the GCA +20 in Shanghai, and the Thirty-fourth Session of COFI welcomed the holding of the GCA +20 and encouraged all Members to participate in it.

Scope and aims

5. The GCA +20 was the fourth in a series of development-oriented conferences with the ambition of shaping global aquaculture.
6. The FAO Technical Conference on Aquaculture (Kyoto, Japan, 1976) reviewed the status, problems, opportunities, and potential for the culture of fish, crustaceans, molluscs, and seaweeds, and declared that the aquaculture sector had made encouraging progress in the past decades, producing significant quantities of nutritious food, income, and employment.
7. The FAO/NACA Conference on Aquaculture in the Third Millennium (Bangkok, Thailand, 2000) adopted *The Bangkok Declaration and Strategy on Aquaculture Development Beyond 2000*, which articulated 17 strategic elements addressing the role of aquaculture in alleviating poverty, enhancing food security, and maintaining the integrity and sustainability of natural resources and the environment. The Strategy suggested measures that incorporate aquaculture into the development programmes of the public and private sectors.
8. The FAO/NACA Global Conference on Aquaculture Millennium +10, (Phuket, Thailand, 2010) adopted the *Phuket Consensus: a re-affirmation of commitment to the Bangkok Declaration*, which recognized the continued value and relevance of the Strategy and identified seven elements that require further strengthening in order to enhance sustainable growth of the sector.
9. Under the theme “Aquaculture for food and sustainable development”, the GCA +20 brought together stakeholders from government, business, academia, and civil society to identify the policy and technology innovations, investment opportunities and fruitful areas of cooperation in aquaculture for food and sustainable development. A key output from the GCA +20, the *Shanghai Declaration on Aquaculture for Food and Sustainable Development*, highlights the priorities, actions, principles, and strategic pathways to maximize sustainable aquaculture in achieving the SDGs, with a special focus on “leaving no one behind”.

10. Specifically, the Global Conference on Aquaculture +20 aimed to:
- Review status, trends, and emerging issues in aquaculture development.
 - Identify opportunities and challenges in aquaculture and its contributions to sustainable development.
 - Evaluate the progress of aquaculture development in light of previously recommended strategies and policies at regional and global level.
 - Build consensus on priorities and actions needed for advancing aquaculture as a global, sustainable, and competitive food production sector.
11. FAO participated in a high-level segment entitled South-South and Triangular Cooperation for Sustainable Aquaculture Development organized by the Ministry of Agriculture and Rural Affairs of the People's Republic of China concurrently with the GCA +20.
12. A poster competition encouraged youth and early career researchers to submit academic posters to the GCA +20. Over 100 posters were received, from which the best from each theme was selected. The nine selected awardees presented their research to the plenary session. The awardees came from many different regions and were comprised of eight youth, of which six were women.
13. A special topic workshop on *Artemia* preceded the GCA +20, co-organized in hybrid format by FAO, NACA, University of Ghent, the Asian Regional Artemia Reference Center and the Artemia Association of China. The workshop was well attended with close to 400 participants (mostly online). The outcomes of the workshop are expected to facilitate the *Artemia* research and industry development needed to sustain the fast growth of aquaculture.

Organization

Preparatory activities

14. To facilitate the preparations for the GCA +20, FAO, NACA and the Ministry of Agriculture and Rural Affairs of the People's Republic of China (MARA) established the GCA +20 Secretariat. The Secretariat coordinated the overall implementation of the conference, prepared communication materials and provided secretariat support to the International Organizing Committee (IOC), the International Programme Committee (IPC) and the Local Organizing Committee (LOC).
15. Originally planned for October 2020, the GCA +20 had to be postponed due to the COVID-19 pandemic. The GCA +20 Secretariat engaged with all partners and determined the revised dates; the GCA +20 was finally held 22–25 September 2021.
16. The GCA +20 Secretariat, in close consultation with the Organizing Committees, arranged opening and closing ceremonies, three keynote speeches, and three special topic presentations. The Secretariat further organized three main workstreams to facilitate the development of technical and policy-relevant documentation and presentations to the GCA +20: (i) Regional Aquaculture Reviews and a Global Synthesis for The State of World Aquaculture 2020, (ii) Thematic Reviews and (iii) Draft *Shanghai Declaration on Aquaculture for Food and Sustainable Development*.
17. The programme of the GCA +20 is attached as Appendix I.
18. A recording of all sessions is available at www.fao.org/webcast (see Appendix I for direct links to the recordings of each session).

International Organizing Committee

19. The IOC, a group of geographically and gender-balanced aquaculture experts, provided guidance throughout the preparatory process on policy issues regarding the conference. The IOC also provided guidance to the other committees to ensure smooth and effective implementation. The list of IOC members is provided in Appendix IX.

International Programme Committee

20. The IPC, a group of geographically and gender-balanced aquaculture experts, oversaw the development and structure of programme themes, including the keynote addresses, guest lectures and thematic sessions. This also included the regional reviews of status and trends, a global synthesis, and the thematic reviews, as well as coordination of the poster session. This work was guided by the overall GCA +20 theme “Aquaculture for food and sustainable development”. The list of IPC members is provided in Appendix IX.

Local Organizing Committee

21. The LOC oversaw the administrative and logistic aspects related to the organization of the GCA +20 in Shanghai. The LOC included representatives from the Bureau of Fisheries of MARA, the China Society of Fisheries (CSF), Shanghai Ocean University (SHOU) and the Shanghai Municipality Council. The list of LOC members is provided in Appendix IX.

Partners

22. Partner organizations were invited to support the GCA +20, especially through their contributions to the Local Organizing Committee. The following partners were involved: 1) SHOU, a multi-disciplinary applied research-based institution of higher education located in the Pudong region of Shanghai; 2) China Society of Fisheries (CSF), which is the national society of fisheries, consisting of scientists and scholars involved in science and innovations of fisheries and aquaculture; 3) Chinese Academy of Fishery Sciences (CAFS), which is the national research institution for fisheries and aquaculture; 4) National Fishery Technology Extension Centre, which is the national institution for fishery and aquaculture technology extension service; and 5) China Aquatic Products Processing and Marketing Alliance (CAPPMA), which is the alliance supporting aquatic food value chain development.

PART II: CONDUCT OF THE GLOBAL CONFERENCE ON AQUACULTURE

Opening ceremony

23. The GCA +20 was held from 22 to 25 September 2021 in Shanghai, the People's Republic of China, in a hybrid format. A total of 1 728 participants from 114 Members attended the conference (500 in-person in Shanghai, 1 228 online), representing a wide range of stakeholders. Overall, more than 2 700 people were registered via the GCA +20 website. The full recording of the GCA +20 opening ceremony is available through the FAO Webcast. Appendix I contains direct links to all recordings.

24. Before the opening speeches, a warm-up session featured a 30-minute video focused on “*Chinese sustainable aquaculture*”.

25. The GCA +20 was officially opened by QU Dongyu, Director-General, FAO, on the afternoon of 23 September 2021. Welcome remarks were delivered by TANG Renjian, Minister for Agriculture and Rural Affairs, Ministry of Agriculture and Rural Affairs of the People's Republic of China, Frank K. Tumwebaze, Minister for Agriculture, Animal Industry and Fisheries, Ministry of Agriculture, Animal Industry and Fisheries of the Republic of Uganda, Úrsula Desilú León Chempén, Vice Minister for Fisheries and Aquaculture, Ministry of Production of the Republic of Peru, Virginijus Sinkevičius, Commissioner for the Environment, Oceans and Fisheries, European Commission, HUANG Jie, Director-General, Network of Aquaculture Centres in Asia-Pacific, and PENG Chenlei, Vice Mayor of Shanghai Municipal Government. The moderator of the opening ceremony was MA Youxiang, Vice Minister, Ministry of Agriculture and Rural Affairs of the People's Republic of China. Opening speeches are available in Appendix II of this report.

26. The technical part of the GCA +20 started with three 30-minute keynote presentations, followed by three 30-minute special topic presentations.

Keynote presentations

27. The first keynote presentation focused on *Sustainability of aquaculture in China: Past and Future*, presented by TANG Qisheng. The second keynote presentation focused on the *Global synthesis of the state of world aquaculture*, presented by Devin Bartley. The third and last keynote presentation focused on the *Shanghai Declaration on Aquaculture for Food and Sustainable Development*, presented by Matthias Halwart. The moderator of the keynote session was Jennifer Cobercroft.

28. Abstracts of keynote presentations are included as Appendix V.

Special topic presentations

29. The first special topic presentation focused on *SME Aquaculture: leading sector growth in sub-Saharan Africa*, jointly presented by Harrison Charo Karisa and Lovin Kobusingye. The second special topic presentation focused on *Investment in aquaculture*, jointly presented by Randall Brummett and Flavio Corsin. The third special topic presentation focused on *Unfed aquaculture and integrated multi-trophic aquaculture: Theories and practices in China*, presented by JIANG Zengjie. The moderator of the special topic session was Maria-Celia Portella.

30. Abstracts of special topic presentations are available in Appendix VI of this report.

Regional reviews of aquaculture and global synthesis

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

32. With the support of NACA and World Fisheries Trust (WFT), and the technical contributions of leading aquaculture development experts and authors, FAO facilitated the preparation of six Regional Aquaculture Reviews and a global synthesis entitled *World Aquaculture 2020 – A brief overview*, as follows:

- Regional review on status and trends in Aquaculture Development in Asia and the Pacific – 2020.
- Regional review on status and trends in Aquaculture Development in Europe – 2020.
- Regional review on status and trends in Aquaculture Development in Latin America and the Caribbean – 2020.
- Regional review on status and trends in Aquaculture Development in the Near East and North Africa – 2020.
- Regional review on status and trends in Aquaculture Development in North America – 2020.
- Regional review on status and trends in Aquaculture Development in sub-Saharan Africa – 2020.
- World Aquaculture 2020 – A brief overview.

33. These reviews were first drafted by selected aquaculture experts and then extensively reviewed by colleagues of FAO, NACA and WFT as well as peer-reviewed by numerous invited experts worldwide. In addition, the draft regional reviews and the global synthesis including their key messages were presented and discussed during seven technical webinars held in October 2020 with the attendance of the authors, invited speakers, panellists, experts, and a total of more than 1 600 participants. This provided opportunities for fruitful exchange and further improvements of the reviews. The Global Synthesis was presented as a keynote speech

to the GCA +20, and participants were referred to the recordings of the October webinars¹ and the full publications of the 2020 regional reviews.²

Thematic reviews

34. A set of nine Thematic Reviews³ was developed to provide additional evidence base for the GCA +20 and to support the drafting of the *Shanghai Declaration on Aquaculture for Food and Sustainable Development*. For each theme, a group of technical experts was convened by FAO and commissioned to produce thematic review papers for corresponding sessions of the GCA +20. These themes, carefully selected by the IPC and chosen for their current and future relevance for the sector, covered technical topics, ranging from innovations in aquaculture systems to developments in feed and feeding practices, and from biosecurity to aquatic genetic resources (AqGR) and seed supply. Value chains, market access and consumer perceptions relate directly to social and human dimensions of aquaculture, including gender, nutrition, and youth employment. Finally, aquaculture policies, planning and governance connect to the needed transformation of aquaculture towards achieving the SDGs. Each Thematic Review considered a number of cross-cutting issues including, among other things, biodiversity mainstreaming, climate change and capacity building.

35. All draft Thematic Reviews were published online for a commenting period of six weeks, with registered participants encouraged to provide input, comments, or other feedback. The final Thematic Reviews, revised based on the feedback received from participants, will be published in mid-2022. Abstracts of the nine Thematic Reviews are included as Appendix VIII.

36. The nine Thematic Reviews are:

- Aquaculture systems.
- Innovations in aquaculture.
- Transforming aquaculture to achieve SDGs.
- Aquaculture feeds and feeding.
- Aquatic genetic resources and seed supply.
- Biosecurity: reducing the burden of disease.
- Dynamics of aquaculture governance.
- Social and human dimensions of aquaculture.
- Value chains and market access for aquaculture products.

37. The nine Thematic Reviews were presented by a core group of experts who prepared them during the GCA +20. Presentations were followed by panel discussions with all participants invited to provide comments and questions.

38. The technical part of the conference was structured in three different “streams” (parallel sessions) that were conducted on 23 and 24 September 2021. Each of the three “streams” included three Thematic Reviews. Each stream was moderated by an international facilitator (who participated virtually in the conference) and a Chinese local moderator present in-person at the conference venue. Overall, all nine Thematic Reviews were presented during the Parallel Sessions.

39. Stream 1 was facilitated by Selina Stead and David Little, and included the following Thematic Reviews:

- Thematic Review 1, titled “Aquaculture systems” was presented by Marc Verdegem as the lead author. Speakers and panellists included U. Win Latt, Sandra Shumway, and Alejandro Buschmann. The local moderator was WANG Qingyin.

¹ www.aquaculture2020.org/regional

² www.fao.org/fishery/regional-aquaculture-reviews/reviews-2020/en

³ www.aquaculture2020.org/thematic

- Thematic Review 2, titled “Innovations in aquaculture” was presented by Neil Anthony Sims as the lead author. Speakers and panellists included Maymyat Noelwin, Alejandro Buschmann, and Albert Tacon. The local moderator was WANG Lumin.
 - Thematic Review 3, titled “Transforming aquaculture to achieve SDGs” was presented by Max Troell and Barry Costa-Pierce as the lead authors. Speakers and panellists included Doris Soto, Selina Stead, Anna Farmery, Richard Cottrell, and Barry Costa-Pierce. The local moderator was XU Pao.
40. Stream 2 was facilitated by Rohana Subasinghe, and included the following Thematic Reviews:
- Thematic Review 4, titled “Aquaculture feed and feeding” was presented by Brett Glencross as the lead author. Speakers and panellists included Kangsen Mai, Luisa Valente, Rodrigo Roubach, and Albert Tacon. The local moderator was XIE Shouqi.
 - Thematic Review 5, titled “Aquatic genetic resources and seed supply” was presented by Ana Sonesson as the lead author. Speakers and panellists included Graham Mair, Eric Hallerman, Fran Humphries, and Rose Basita. The local moderator was CHEN Songlin.
 - Thematic Review 6, titled “Biosecurity: reducing the burden of disease” was presented by Rohana Subasinghe as the lead author. Speakers and panellists were Victoria Alday-Sanz, Rohana Subasinghe, Peter de Schryver, Melba Reantaso, Patrick Sorgeloos, and HUANG Jie. The local moderator was ZHANG Qingli.
41. Stream 3 was facilitated by Melanie Siggs, and included the following Thematic Reviews:
- Thematic Review 7, titled “*Dynamics of aquaculture governance*” was presented by Curtis Jolly as the lead author. Speakers and panellists included Beatrice Nyandat, YANG Zhengyong, Felipe Matias, Ana Menezes, and Neil Ridler. The local moderator was YANG Zhengyong.
 - Thematic Review 8, titled “*Social and human dimensions of aquaculture*” was presented by Cecile Brugere as the lead author. Speakers and panellists included Tulika Bansal, Froukje Kruijssen, Meryl Williams, and Sebastian Mathew. The local moderator was TANG Yi.
 - Thematic Review 9, titled “*Value chains and market access for aquaculture products*” was presented by Lahsen Ababouch as the lead author. Speakers and panellists included Jose Fernandez Polanco, Nguyen Kim Anh, Mariana Toussaint, David Vivas Eugui, and Majida Maarouf. The local moderator was ZHU Yaping.

Poster session

42. A total of 177 posters were accepted for display during the conference. All posters were made available at the GCA +20 website⁴ prior and during the conference, as well as presented physically at the conference venue in Shanghai.

43. Prior to the conference, the accepted posters were assessed within each thematic area by a selected group of aquaculture experts under the overall guidance of the IPC, based on the following evaluation criteria: 1) academic quality; 2) relevance to the thematic area, and overall conference objectives; and 3) preference was given to youth and those from developing countries. Based on this assessment, one poster was selected within each thematic area to present during the Poster Session.

44. The Poster Session was conducted on 24 September 2021. This session was moderated by Austin Stankus and ZHANG Junfang. Each of the nine poster authors briefly presented their posters, and were then recognized by Audun Lem, Deputy Director of the Fisheries and Aquaculture Division of FAO. The list of awarded posters is provided in Appendix X of this report.

⁴ www.aquaculture2020.org/posters

Shanghai Declaration on Aquaculture for Food and Sustainable Development Session

45. The *Shanghai Declaration on Aquaculture for Food and Sustainable Development*, a key output from the GCA +20, represents a roadmap to optimize the role that aquaculture can play in achieving the 2030 Agenda for Sustainable Development. The Shanghai Declaration was drafted by a small group of globally recognized aquaculture experts, followed by consultations with a wider group – the Friends of the *Shanghai Declaration on Aquaculture for Food and Sustainable Development* – with appropriate technical, regional and gender balance, including the members of the IOC and the IPC. The key messages of the Regional Reviews, Global Synthesis and Thematic Reviews guided its development. The resulting “pre-final” version of the Declaration was then made available to the more than 2 700 registered participants of the GCA +20 for an open commenting period. Comments were integrated into the final draft Shanghai Declaration which was presented to the GCA +20 in plenary on the first day.

46. The adoption session was moderated by Meryl Williams on behalf of the Friends of the *Shanghai Declaration on Aquaculture for Food and Sustainable Development*, leading to its unanimous adoption by the participants of the GCA +20 on 24 September 2021. The *Shanghai Declaration on Aquaculture for Food and Sustainable Development* is included as Appendix XI of this report.

47. Following the adoption, Her Royal Highness Princess Maha Chakri Sirindhorn, FAO Special Goodwill Ambassador for Asia and the Pacific, provided a statement to the GCA +20 expressing her support of aquaculture as a global solution to reach Sustainable Development Goal 2: Zero Hunger, to save the peoples of the world threatened by pandemic, climate change, environmental degradation, and frequent natural calamity. The full statement provided by Her Royal Highness is included as Appendix III of this report.

48. More than forty organizations and institutions submitted pledges and statements of support to the *Shanghai Declaration on Aquaculture for Food and Sustainable Development*, some twenty of which presented after its adoption. The contents ranged from general recognition of the Declaration and stressing the importance of its call of action to specific commitments and responses such as by establishing a global Center for Ecological Aquaculture. The list of organizations and institutions that submitted pledges and statements of support to the *Shanghai Declaration on Aquaculture for Food and Sustainable Development* are included as Appendix XII and on the GCA+20 website.⁵

49. The *Shanghai Declaration on Aquaculture for Food and Sustainable Development* highlights the principles and pathways to maximize sustainable aquaculture in achieving the SDGs, and specifically presents i) a shared vision of sustainable aquaculture; ii) five overarching commitments; iii) ten strategic priorities; and iv) a call for action. The Declaration identifies global priorities and actions related to aquaculture’s role in implementing and mainstreaming the SDGs and, over the next 10 years, to optimizing the contribution of aquaculture towards achieving the 2030 Agenda for Sustainable Development. The unanimous adoption of the Declaration by the conference participants represents an important milestone for global aquaculture, and stakeholders are invited and encouraged to consider it when working towards sustainable aquaculture.

Closing ceremony

50. The official closing of the GCA +20 on 24 September 2021 was given by Maria Helena Semedo, Deputy Director General of FAO, MA Youxiang, Vice Minister, Ministry of Agriculture and Rural Affairs of the People's Republic of China, and HUANG Jie, Director-General of NACA. The moderator of the Closing Ceremony was Ismahane Elouafi, Chief Scientist of FAO. The closing speeches are included as Appendix IV of this report.

⁵ The *Shanghai Declaration on Aquaculture for Food and Sustainable Development*, available in Arabic, Chinese, French, English, Russian, and Spanish languages, as well as the pledges and statements of support, available in the language they were submitted, can be found at www.aquaculture2020.org/declaration

PART III: SALIENT POINTS OF GLOBAL SYNTHESIS AND REGIONAL REVIEWS ON AQUACULTURE

World Aquaculture 2020: A brief overview

51. The global synthesis of the state of *World Aquaculture 2020 – A brief overview* was presented by Devin Bartley as one of the keynote presentations that followed the opening ceremony, focusing on the most important findings. The abstract of the global synthesis is included as Appendix VII. The global synthesis was coordinated by Uwe Bard, with Devin Bartley as lead author. Salient points of the global synthesis are:

- 2018 was a record year for aquaculture production.
- In 2018, 114.5 million tonnes were produced worldwide.
- In 2018, the aquaculture production was valued at around USD 263.6 billion.
- In 2018, the total production of aquatic animals was 82.1 million tonnes (USD 250.1 billion).
- In 2018, the total production of aquatic plants was 32.4 million tonnes (USD 13.3 billion).
- The aquaculture sector contributed to more than 50 percent of the seafood consumed.
- Asia (specifically China) was the top producer.
- Developing countries continued to produce the majority of farmed aquatic species.
- A few developed countries continued to be strong producers.
- In some areas, such as Northern America and Oceania, production was levelled; however, policies are and were in place to increase production.
- Farming systems, including cages, ponds, raceways, intensive recirculating to low input extensive systems with large- and small-scale operations were promoted.
- Environments and habitats from temperate oceans to tropical rice fields were targeted.
- In 2018, around 466 species comprised species of fish, molluscs, crustaceans, echinoderms, vascular plants, seaweeds, and micro-organisms were reported to be farmed.
- Newer systems were applied, including aquaponics, which is expanding in some areas where water and land are scarce, and innovative systems using bio floc showed promising results in tilapia and shrimp farming.
- In 2018, a balance between large- and small-scale aquaculture enterprises was assessed.
- The Regional Reviews on Aquaculture were presented in a series of virtual webinars conducted in October 2020, at the dates where the GCA +20 was supposed to be held; therefore, they were not presented during the conference.

Regional review on status and trends in aquaculture development in Asia and the Pacific

52. The abstract of the Regional Review of Aquaculture in Asia and the Pacific is provided as Appendix VII. This regional review was coordinated by MIAO Weimin, with YUAN Derun as the lead author. Salient points of the Regional Review of Aquaculture in Asia and the Pacific are:

- Aquaculture in the Asia-Pacific region continued to grow from 2008 to 2018 at an average annual growth rate of 5.2 percent.
- Total aquaculture production in the region reached a historical high of 105 million tonnes in 2018, which accounted for 92 percent of global aquaculture production.
- South-East Asia produced 90 percent of the region's total, while negligible production was observed from Oceania and Central Asia, accounting for 0.3 percent of the region's total.
- Aquaculture contributed significantly to achieving SDGs in the region. It provided over 60 percent of the 2017 average annual per capita food fish consumption in the region of 24.1 kg, supplying 25.2 percent of the average animal protein intake.
- The total value of aquaculture production in the region reached USD 223 billion and the sector directly employed 19.6 million people across the region in primary production and about the same number of people in related supporting and service businesses in 2018.
- Aquaculture in the region has been making good progress to address its negative impact on the environment and adapt to climate change for sustainability and resilience. It also contributes to

conservation of aquatic biodiversity with hatchery seed production of endangered species for production and wild stock enhancement.

Regional review on status and trends in aquaculture development in Europe

53. The abstract of the Regional Review of Aquaculture in Europe is provided as Appendix VII. This review was coordinated by Uwe Barg, with Courtney Hough as the lead author. Salient points of the Regional Review of Aquaculture in Europe are:

- Aquaculture production in the European Region is composed principally of marine molluscs and diadromous, marine, and freshwater fish.
- It reached 3.4 million tonnes in 2018 which is 4.8 percent of the global total for aquaculture fish and shellfish, while having a value of USD 16.6 billion.
- Ten European states produce more than 50 000 tonnes annually. The growth in value (5.8 percent) is higher than production (0.9 percent), which is now dominated by salmonids (nearly 60 percent), primarily Atlantic salmon. The financial share is taken principally by northern Europe (65 percent) followed by southern Europe (20 percent), while western and eastern Europe represent seven percent each. In 2018, the non-European Union, European countries accounted for 55 percent of production, 41.5 percent of export volume and 15.1 percent of imported volume.
- The European Union is the world's largest single market for seafood and the most important destination for European aquaculture production. In 2017, supplies were 14.6 million tonnes worth USD 38 billion with a trade deficit of USD 24.5 billion. Apparent consumption in the European Union was 24.35 kg per capita of which 6.35 kg (26 percent) was from aquaculture.
- In the European Region, apparent consumption is lower at 19.9 kg per capita.

Regional review on status and trends in aquaculture development in Latin America and the Caribbean

54. The abstract of the Regional Review of Aquaculture in Latin America and the Caribbean (LAC) is provided as Appendix VII. This review was coordinated by Alessandro Lovatelli, with Carlos Wurmman, Doris Soto and Ricardo Norambuena as lead authors. Salient points of the Regional Review of Aquaculture in LAC are:

- Aquaculture in the Latin-America and the Caribbean region resulted in 3.1 million tonnes of fish, shellfish, and molluscs (excluding seaweeds) in 2018, worth USD 17.2 billion at first sale.
- Over the last five years, the quantity of production has grown by an average of 5.6 percent per year, compared to 8.3 percent per year in the period 2000 to 2010. This compares to average world aquaculture growth rates of 4.2 percent per year over the last five years and 5.9 percent over the period 2000 to 2010.
- The recent reduction in growth rates in LAC region may in part be due to poor governance and public perception or acceptance of aquaculture. Nevertheless, aquaculture contributed 17.9 percent towards total fish production in the region in 2018, compared with only four percent in 2000 and if current trends continue, it is expected that LAC aquaculture production will reach 4.6 million tonnes in 2030.
- Apart from some local exceptions, per capita seafood consumption rates in LAC region are low at around 10 kg per year which is approximately half of the global average. Except in Brazil, Cuba and Colombia, most aquaculture production is for export.
- Local eating preferences strongly favour poultry and pork that are cheaper or more accessible than fish and red meat.
- The growing population of LAC reached 654 million in 2020 with a high proportion of urban residents, but with low average population densities.
- LAC aquaculture is highly concentrated in a few countries with the combined output from Chile, Ecuador, Brazil, Mexico, and Colombia representing 85 percent to 90 percent of total LAC production. Salmonids and tilapia are the main finfish products, while whiteleg shrimp and Chilean mussels are the main shellfish products. The average unit value (USD/kg) of LAC aquaculture products is much higher than for all other continents except Oceania.

- About 70 percent of farmed output is from a few introduced species, although over 90 species were farmed in 2018. Whiteleg shrimp, Atlantic salmon, Nile tilapia, Chilean mussel and rainbow trout, in decreasing order, together contributed 80.4 percent of regional production volume and 85.9 percent of value. Farming has focused on these species and production has increased in recent years, despite efforts towards diversification. Out of 91 species farmed, only 22 resulted in production of more than 5 000 tonnes in 2018.
- Technology gaps, poor research and development (R&D) strategies, fragmented public policies, localized markets and marketing issues, as well as relatively high prices have all contributed to this.
- The small island developing states (SIDS) face additional challenges including inadequate national legal and policy frameworks and support systems, limited expertise, high production costs due to the high cost of inputs and challenges with seed supplies, as well as biosecurity problems and natural disasters such as storms, floods, and drought.

Regional review on status and trends in aquaculture development in the Near East and North Africa

55. The abstract of the Regional Review of Aquaculture in the Near East and North Africa is provided as Appendix VII. This review was coordinated by Alessandro Lovatelli, with Malcolm Dickson as lead author. Salient points of the Regional Review of Aquaculture in the Near East and North Africa are:

- The region's aquaculture production was worth USD 2.3 billion in 2018, two-thirds of which came from Egypt and around one-quarter from Saudi Arabia. Production has grown rapidly since the 1980s, more than doubling over ten years and increasing by 50 percent over the five years preceding 2018 to reach 1.7 million tonnes. Egyptian fish farms accounted for 92 percent of production and Saudi Arabia for 4.2 percent while other significant producers included Iraq (25 737 tonnes), Tunisia (21 826 tonnes), Algeria (5 100 tonnes), the United Arab Emirates (3 350 tonnes) and the Syrian Arab Republic (2 350 tonnes). Although current aquaculture production levels are low, all these countries have high ambitions with further developing the sector, often for improved food self-sufficiency.
- A total of 43 species of finfish, shellfish and aquatic plants were farmed in the region. Tilapia (mainly Nile tilapia) was produced in 14 of the 17 countries in the Near East and North Africa (NENA) and represented 63 percent of total 2018 production, followed by mullets (14 percent) and carps (12 percent).
- Marine finfish (gilthead seabream, European seabass, and meagre) represented around six percent of total production and shrimp (mainly whiteleg shrimp produced by Saudi Arabia) accounted for around three percent. The capacity to grow tropical marine finfish such as grouper, amberjack and yellowtail is increasing in all the Gulf States, but the quantities remain limited, while Asian seabass was mainly produced in Saudi Arabia and the United Arab Emirates.
- Small amounts of bivalve shellfish are grown in Algeria, Morocco, and Tunisia and more recently in the United Arab Emirates while even smaller quantities of aquatic plants are grown in Morocco and Tunisia. There is good potential for further growth of aquaculture production in the region through sustainable intensification of inland, freshwater, and brackish water aquaculture as well as expansion of marine aquaculture systems backed by strong policy and financial support.
- Egyptian aquaculture production was built on commitments by the government to allocate space and resources for development of the sector in the 1980s.
- Similar commitments have been made recently in other NENA countries including Bahrain, Morocco, Oman, Saudi Arabia, and the United Arab Emirates including establishing dedicated aquaculture development zones and carrying out consultation processes with other resource users as recommended in the FAO Ecosystem Approach to Aquaculture (EAA).
- Fish farmers need to improve the efficiency of feed and water use while fish health can be improved by implementing the FAO Progressive Management Pathway approach.
- Environmental legislation has been enacted by most countries, although management systems need to be strengthened.

Regional review on status and trends in aquaculture development in North America

56. The abstract of the Regional Review of Aquaculture in North America is provided as Appendix VII. This review was coordinated by Austin Stankus, with Steve Cross as lead author. Salient points of the Regional Review of Aquaculture in North America are:

- North America contributes a small and relatively steady level of aquaculture production (600 000 tonnes to 650 000 tonnes annually), but despite the steady production volume, the value of production has continued to rise over the past 25 years.
- Growing global demand for diverse seafood products is probably stimulating local production increases and trade agreements are currently being re-structured and expanded beyond North American parties.
- The increasing value of products over time has been attributed to value-addition initiatives, including branding, eco-certification, processing, and packaging so sector growth should continue to embrace such initiatives and to address consumer needs, through further diversification of product lines.
- Growing interest in species diversification has been attributed to challenges associated with environmental sustainability, such as reducing farm impacts, as climate change adaptation strategies, and business risk mitigators in regions affected by fluctuating or uncertain seafood product demand as well as price competition from imported products.
- Technology innovations and their application have contributed to increases in on-farm productivity and decreased production costs.
- Social license, and the negative public perceptions of the aquaculture industry, continue to have an impact on growth, although industry actions to improve its image are becoming increasingly effective.
- With extensive and optimal growing conditions, the region is beginning to embrace the opportunities associated with seaweed aquaculture.
- The regulatory burden for the aquaculture sector has remained high, with sometime poorly harmonized regulations having an impact on the cost of doing business. Current initiatives in Canada and the United States of America are addressing these constraints to growth.

Regional review on status and trends in aquaculture development in sub-Saharan Africa

57. The abstract of the Regional Review of Aquaculture in sub-Saharan Africa (SSA) is provided as Appendix VII. This review was coordinated by Ana Menezes and Pierre Murekezi, with Blessing Mapfumo as lead author. Salient points of the Regional Review of Aquaculture in sub-Saharan Africa are:

- There has been a significant increase in the prioritization of aquaculture in sub-Saharan Africa in government policies and strategies, linked to increased public understanding.
- Aquaculture production growth rates have decelerated in recent years, with some exceptions.
- Strengthened mainstreaming is required for disaster risk reduction, mitigation, and resilience in aquaculture development strategies.
- Long-standing aquaculture challenges remain including tenure issues, the cost of inputs, inadequate technologies, genetic and environmental integrity, biosecurity, and access to financing.
- Special programmes are needed to foster aquaculture development and implementation of the Blue Economy Agenda including addressing the participation of women and youth in aquaculture and strengthening continental networking institutions.
- Technical and financial assistance from international partners needs to continue.
- The SSA is a region with diverse geography and environmental landscapes, ranging from tropical rainforests and rift valleys with some of the largest and most ecologically diverse freshwater systems in the world, to highland plateaus, semi-arid plains, deserts, and cool temperate, marine environments. In general, the environmental potential for aquaculture could be considered as unfulfilled in most areas of SSA. However, the inherent natural potential of the region and rapidly increasing demand for fish has resulted in increased prioritization of aquaculture in almost all SSA countries.

PART IV: SALIENT POINTS OF THEMATIC SESSIONS

Thematic review 1: Aquaculture systems

58. The Thematic Session on *Aquaculture systems* was conducted on 23 September 2021 as a parallel session under Stream 1. The Thematic Session was coordinated by Alessandro Lovatelli and led by Marc Verdegem, who was the lead author of this Thematic Review. The session presented the following salient points regarding current and future trends, challenges, and opportunities on aquaculture systems:

- Research to reduce global warming from aquaculture should be a priority.
- The aquaculture sector should continue to improve and promote sustainable and environmentally sound practices.
- The ocean should be used more effectively, efficiently, and intelligently to produce food for a growing human population.
- In areas with a high potential for shellfish or seaweed production, aquaculture needs to be stimulated by improving licensing procedures, educating the public, and implementing smart technologies.
- Aquaculture development in Africa and Latin America should be actively stimulated, with the aim of distributing aquaculture more evenly across countries on each continent and between continents globally.
- The use of technologies to collect, treat, and re-use aquaculture wastes in a responsible way should become the standard in any aquaculture operation throughout the industry.
- The aquaculture industry should aim to integrate aquaculture in nutrition-sensitive food systems, and actively advertise the contribution of aquaculture products to a nutritious diet.
- The aquaculture industry should explore the use of smart technology to improve farming efficiency and reduce production costs across the industry, especially for shellfish and seaweed culture.

Thematic review 2: Innovation in aquaculture

59. The Thematic Session on *Innovations in aquaculture* was conducted on 24 September 2021 as a parallel session under Stream 1. The Thematic Session was coordinated by Alessandro Lovatelli and led by Neil Anthony Sims, who was the lead author of this Thematic Review. The session presented the following salient points regarding current and future trends, challenges, and opportunities on innovations on aquaculture:

- Stakeholders should assertively focus greater support to aquaculture expansion, in order to reduce the overall impact of food production systems on the global climate crisis, freshwater use, and land use, with concomitantly less support for more-impactful terrestrial animal proteins.
- Stakeholders should expand the use in aquaculture of feeds based on agricultural proteins and oils, including both crops and animal by-products, as well as optimizing the use of seafood processing by-products.
- Stakeholders should encourage the use of innovative financial models, particularly for new start-up companies, and offering pre-permitting of areas for aquaculture use.
- Stakeholders should balance the dominance of larger-scale operations by supporting greater cooperative efforts for smaller-scale operators, such as application of the ‘nucleus estate’ model.
- Stakeholders should assist with the replication of selective breeding programs to broader their benefits, such as the Genetically Improved Farmed Tilapia (GIFT) programme, in other aquaculture species.
- Stakeholders should establish collaborative programmes to preserve genetic resources in wild populations, such as for the slower-growing but more salt-tolerant tilapia species in Mozambique (*Oreochromis mossambicus*).
- Stakeholders should foster private sector, pre-competitive collaborations (such as the Global Salmon Initiative) to address better aquaculture’s challenges.

Thematic review 3: Transforming aquaculture's contribution to the SDGs

60. The Thematic Session on *Transforming aquaculture's contribution to the SDGs* was conducted on 24 September 2021 as a parallel session under Stream 1. The Thematic Session was coordinated by Uwe Barg and led by Max Troell and Barry Costa-Pierce, who were the lead authors of this Thematic Review. The session

presented the following salient points regarding current and future trends, challenges, and opportunities on transforming aquaculture's contribution to the SDGs:

- Aquaculture contributes to all 17 SDGs but where data exists to evidence its impact are those related to A – eliminating hunger and improving health (SDGs 2, 3); B – increasing environmental sustainability of oceans, water, climate, and land through responsible production/consumption (SDGs 6, 12, 13, 14, and 15), and C – reducing poverty, achieving gender equality, improving livelihoods, and reducing inequalities (SDGs 1, 5, 8, and 10).
- Aquaculture is an important sector which contributes to human wellbeing, but better linkages between aquaculture, health, the broader food system, and natural resource management policy and practice need to be established for the sector to play a greater role in efforts to achieve the SDGs in this generation.
- Acknowledgement – and better identification – of aquaculture's present and future potential role in the global food system, for example for rural and urban development (and redevelopment), for healthy and sustainable diets, for human health and wellness, will improve our understanding of its potential for positive contributions to many of the SDGs and influence effectiveness of policies and impact.
- Integration of land and ocean-based aquaculture with emerging renewable energy systems, existing agricultural systems and other sectors of the economy (for example tourism) to accelerate aquaculture's contributions to the SDGs should be further explored to build cohesive strategies with common goals.
- Key institutions at the global to local levels need to monitor aquaculture's contribution to the different SDG indicators through existing structures, while also continuing to build on these and to develop new tools that capture the wider benefits of aquaculture. Such monitoring is also essential to compare and demonstrate aquaculture impacts and trade-offs with respect to other food systems and livelihoods.
- Having a broader value-chain perspective will be imperative for gaining deeper insights about aquaculture's overall contribution to the SDGs, for understanding outcomes from investments and transformation efforts especially in diversifying supply chains and livelihoods.
- Understanding the specific contexts in which aquaculture development will be embedded is needed to realize how aquaculture can deliver on the SDGs (locally and globally). Different contexts determine how aquaculture production and value chains will generate benefits (and impacts) for society and the environment, framed by both local characteristics and global connections, including relationship to distant resource systems (for example feed ingredients) and markets (export benefiting consumers elsewhere, and so on). Identifying and considering trade-offs at local and global scale – including local negative impacts and more distant benefits – will be important for enhancing supportive governance processes.
- Inequalities resulting from some aquaculture developments threaten achieving sustainable aquaculture and meeting the SDGs. Applying a SDGs lens to aquaculture development enables a deeper understanding of social-ecological equity and food justice outcomes, thus enhancing self-regulatory operations.
- Data representing values/benefits from the aquaculture sector need to be more detailed regarding gender. The specific role of aquaculture for the SDGs is generally not obvious due to lack of disaggregation of gendered data for livelihoods in the capture fishery and aquaculture sectors. Better disaggregation at various scales, including household level, enables quantification of specific aquaculture benefits and dependency. This information is commonly unavailable.
- Improved ability to gain a social license to operate for ocean/aquatic food systems, especially aquaculture, will require accelerated education on wider benefits for local decision makers and the public to make informed choices. Consumers' understanding of aquaculture's role for achieving the SDGs is essential. New narratives that are evidence-based are needed to help combat the negative image of the sector which impacts political will.
- Learning how global risks and emerging climate challenges relate to performance of various aquaculture systems is urgently needed to build resilient strategies able to enable faster recovery from the impacts of COVID-19 and other external global events such as the financial crisis in 2008. A nuanced understanding will be key in national and international development agendas (food, livelihoods, conservation, and restoration-aquaculture, and so on).

Thematic review 4: Aquaculture feed and feeding

61. The Thematic Session on *Aquaculture feed and feeding* was conducted on 23 September 2021 as a parallel session under Stream 2. The Thematic Session was coordinated by Rodrigo Roubach and led by Brett Glencross, who was the lead author of this Thematic Review. The session presented the following salient points regarding current and future trends, challenges, and opportunities on aquaculture feed and feeding:

- There has been substantial progress in improving feeds and feeding for most aquaculture species, with notable improvements in feed efficiency (through a better understanding of requirements and improved feed management) and ingredient sustainability (through increased capability to use a wider range of ingredients).
- While advances have been made in understanding the requirements of some of the main aquaculture species, there is still much to be done on defining requirements, especially for many of the species being farmed in developing countries.
- Gains in the efficiency of feeds are slowing for developed species, but such gains are still appreciable for less developed species.
- There is an emerging need to adopt a "precision nutrition" approach to the supply of essential nutrients and various additives in the diet based on age, genotype, environment, and immune status.
- Plant resources have become the dominant ingredient used in feeds across the world. Although marine resources remain an important inclusion in many feeds, they are increasingly seen as a low-volume high-value resource with strategic applications. Marine sources of omega-3 still dominate supply, though microalgal and genetically modified crop options are emerging.
- There remains a need to diversify our ingredient options to increase resilience, as the sustainability of different feed ingredient sources, including possible climate change impacts, is becoming a growing issue. There is an increased demand for bio-circularity in our feed ingredient supply chains. The increasing use of new and varied resources will ensure that food safety remains an important issue throughout the world.
- Feed manufacturing has evolved from a simplistic exercise to a highly complex science with state-of-the-art engineering. However, the application of such advanced feed manufacturing is not consistent across all sectors and further support is needed, as there is still widespread use of pelleting, mash, and trash-fish feeding in developing countries.
- Feed management has also dichotomised between the developed and developing world, with a high reliance on manual skilled labour in the developing world, contrasting advanced aquaculture systems that are increasingly reliant on automated computer-controlled feeding systems in the developed world.
- Improved feed design, manufacturing and management systems are supporting better feeds and feeding, resulting in faster growing fish (through better specifications and higher intakes) and lower feed conversion ratios (through more efficient feeds and less wastage), but declining employment in the sector as automation increases.

Thematic review 5: Aquatic genetic resources and seed supply

62. The Thematic Session on *Aquatic genetic resources and seed supply* was conducted on 24 September 2021 as a parallel session under Stream 2. The Thematic Session was coordinated by Graham Mair and led by Ana Sonesson, who was the lead author of this Thematic Review. The session presented the following salient points regarding current and future trends, challenges, and opportunities on AqGR and seed supply.

Conservation and sustainable use

63. The conservation status of wild relatives of farmed AqGR is threatened for some species, but there is an overall lack of information on the genetic status of most wild relative stocks. For most cultured aquatic species, there is a similar lack of information on genetic status, particularly below the level of species (including farmed types). This lack of information constrains the implementation of effective conservation and genetic management for their long-term sustainable use.

64. To enhance understanding of the genetic status of key farmed aquatic types and plan necessary interventions to conserve genetic variation for the future, there is a need to identify key threatened genetic resources with a focus on wild relatives, and to develop information systems that will enhance the monitoring of farmed types and the identification of threaten wild-relative genetic resources. Based on this identification, specific *in situ* and/or *ex situ* conservation programmes should be developed.

65. Cost effective molecular tools to enable widespread monitoring of the genetic status of domesticated farmed types should be developed and applied within major seed supply systems, enabling targeted interventions to secure the future potential for development and conservation of these resources.

Risk assessment and management of non-native and developed farmed types

66. Culture of non-native species and well-developed farmed types delivers economic benefit to aquaculture and underpins significant aquaculture production in many countries, but also can pose environmental/ecological risks to natural ecosystems and genetic risks to native AqGR including conspecifics.

67. There is a need to apply existing frameworks to assess, communicate and manage risks of culture of non-native species and developed farmed types, and to assess the possibilities of expanded culture of native species.

68. Responsible stakeholders in member countries should develop and apply policies and provide training to promote utilization of the risk assessment framework to culture of non-native and developed native species to promote sustainability of their aquaculture sector.

Genetic improvement

69. Selective breeding is a proven and powerful tool to increase production efficiency, product quality and disease resistance, among other traits. The principles of selective breeding are well established and transferrable with adaptation to the reproductive specificities and production systems of any species, with the potential to deliver large long-term benefits for the aquaculture industry. There is a low uptake of selective breeding, and it is evident that the potential of selective breeding is heavily underutilised in aquaculture.

70. In order to increase the uptake of selective breeding in domesticated aquaculture farmed types, especially for incipient farming systems and aquaculture activities producing low-value species in both developing and developed countries, it is necessary to develop applicable business plans, breeding plans and long-term financial support instruments.

Thematic review 6: Biosecurity: reducing the burden of disease

71. The Thematic Session on *Biosecurity: reducing the burden of disease* was conducted on 24 September 2021 as a parallel session under Stream 2. The Thematic Session was coordinated by Melba Reantaso and led by Rohana Subasinghe, who was the lead author of the Thematic Review on this topic. The session presented the following salient points regarding current and future trends, challenges, and opportunities on biosecurity: reducing the burden of disease. Considering the “burden of disease” in aquaculture and the substantial social and economic impacts it poses, biosecurity, disease control and health management should be recognized as an integral part of the global aquaculture development strategy. The states therefore should:

- Recognize that “prevention is better than cure”, and implement good farming and biosecurity strategies, which include the use of clean and healthy seed and broodstock, that would minimize production systems and practices’ exposure to pathogens.
- Strengthen regulatory frameworks on movement of live aquatic animals, aquatic plants, and aquaculture inputs to reduce the risks of direct or indirect introduction, establishment and spread of aquatic animal pathogens and resulting impacts on aquatic biodiversity.

- Increase research, especially in the field of molecular and genetic technologies (metagenomics and pathobiome), to develop pathogen-free, disease-tolerant or disease resistant broodstock and seed, vaccination, accurate and sensitive diagnostic tools, safe therapeutants, alternatives to antimicrobials, and effective control method for reoccurring and emerging diseases and pathogens, which are affordable and accessible to all scales of aquaculture.
- Enhance communication and dialogue among stakeholders, improve disease reporting, strengthen emergency response, implement surveillance, apply smart biosecurity, and promote holistic and risk based Progressive Management Pathway to minimize global spread of diseases.
- Improve capacity to prevent diseases and manage aquaculture health at national, regional, and global levels.
- Recognize the threat of emergence of antimicrobial agent resistance associated with aquaculture and the aquatic environments; taking actions along One-Health goals on prudent use of antimicrobials and provision of adequate support services to the industry and to acquire good data.

Thematic review 7: Dynamics of aquaculture governance

72. The Thematic Session on *Dynamics of aquaculture governance* was conducted on 23 September 2021 as a parallel session under Stream 3. The Thematic Session was led by Curtis Jolly, who is the lead author of the Thematic Review on this topic. The session presented the following salient points regarding current and future trends, challenges, and opportunities on dynamics of aquaculture governance:

- The future advancement of aquaculture development towards the SDG depends on local, national, and global actors, operating through alliances to increase aquaculture production that generates sustainable benefits to stakeholders while preserving the environment and social stability. The choices to be made involve decisions related to environmental quality, foreign direct investment (FDI), domestic capital mobilization, national economic strategies, and new globalized mechanisms supporting aquaculture production at a reasonable cost. The role of the FDI in the production of traded goods and services should be directed to encourage the participation of all stakeholders in the governance of the industry.
- Over the past decade, there has been rising concerns for the social and environmental impacts generated by large-scale investments and export-oriented trade regimes. The desire of all stakeholders is the accessibility of supportive, dedicated legislation with a lead agency to coordinate regulations that ensure public wellbeing and yet not overly constraining to permit them to cope with environmental and social challenges and approach the stipulated SDG.
- The enforcement of good governance may result in challenges that simultaneously offer opportunities for cross-national learning and the development of best practices. Information transfer and data sharing can be interactive and assist in the solution of problems usually encountered by the most resource poor farmers or businesses. Easy communication of ideas can advance the monitoring and reporting of disease and pathogen prevalence in all countries, but the requirements in terms of testing intervals, public disclosure of information, and thresholds for mitigation and remedial action may vary substantially. Added transferred knowledge may reduce farmers' risk, increase production, and reduce losses of traded products.
- An important point within the global market is the growing importance of international agreements that involves food (and fish) safety aspects. Aquaculture export earning is the principal driving force behind aquaculture development in many developing and developed countries. In order to increase or maintain market share, aquaculture producers must diversify and comply to regulations imposed by the importing countries or international regulatory bodies. The conformity to standards imposed by outside bodies generates a compliance cost due to the structural, domestic changes that must be made to receive certification. The compliance costs associated with improvement in standards and certification schemes can inflict a burden on producers to which the importers may be insensitive or unaware. The existing asymmetry of information flows may result in conflicts which can only be solved through a platform of open dialogue, as part of good governance.
- The use of electronic marketing capabilities including mobile phones and tablets, and other electronic mobile devices for information dissemination and rapid communication may influence future governance. Successful operation of these devices requires reorganization, regionalization, nationalization, and internationalization of the whole digitalization process aided by research and

extension efforts for diffusion and adoption of appropriate information that result in transparency, accountability, and predictability.

- It is hoped that in the future there will be a common electronic platform for communication of procedures and rules of engagement, certification, standards, and regulation that facilitate product and information flows through the supply chain.
- This will be possible only through a coalition of public-private partnerships in research and technological innovation with the aim to ensure sustainability. This requires the harmonization of national and international regulations that would foster an increase food quality protection and provide the drive to attain the SDG.
- The development of aquaculture and the attainment of the SDGs are challenging using current material and technical base of farm ponds. There is a need for a new approach to increase the use of digital technologies such as the Industrial Internet, large data banks and a unified system of data storage, processing and utilization with more intense and holistic organized production systems, marketing, education and extension information diffusion. The implementation of digitalization can only ensure an increase in competitiveness of production and marketing while ensuring good governance.
- Countries with limited land and ocean resources for inland and offshore aquaculture must seek new innovative ways of aquaculture expansion. The desirability of zoning and integrated coastal planning to ensure collaboration with competing users to minimize environmental and social conflicts is a relevant consideration. This should be accompanied by new innovations and technologies that range from on-shore tanks, recirculating systems to open-sea systems. The new technologies have the advantage of enhancing the criteria for sustainability if supported by good governance.
- Aquaculture development and sustainability face opportunities and challenges in both developed and developing countries in the attainment of the SDGs. However, the encouragement of the incorporation of the SDGs within the policies and programmes of all countries will increase the awareness of all governments and stakeholders and will empower them to promote with urgency the strengthening of aquaculture governance mechanisms and ensuring fair and transparent involvement and consultation in decision-making of different interest groups concerned with aquaculture development that will foster the sustainable attainment of the SDG.
- FAO, and specially the COFI and its Sub-Committee on Aquaculture as a leading forum, has a role in the global governance of aquaculture and should be supported by member states in further consideration of concrete actions for the sector in accordance with their national plans, capacities, and priorities. The government should pledge support in the development of a platform for information exchanges on the economic, social, and environmental dimensions of sustainable development and on climate change adaptation and mitigation, the development of the voluntary Guidelines for Sustainable Aquaculture as a tool towards further development of national policies for the aquaculture sector's sustainability. Emerging concepts such as the One Health, Nutrition-Sensitive Agriculture/Aquaculture and Blue Transformation to influence the development of sustainable aquaculture and its future trajectory should also be recognized and endorsed as guiding instruments towards better aquaculture governance.

Thematic review 8: Social and human dimensions of aquaculture

73. The Thematic Session on *Social and human dimensions of aquaculture* was conducted on 24 September 2021 as a parallel session under Stream 3. The Thematic Session was coordinated by Ana Menezes and led by Cecile Brugère, who is the lead author of the Thematic Review on this topic. The session presented the following salient points regarding current and future trends, challenges, and opportunities on human and social dimensions of aquaculture:

- **Message 1 – Neglected social and human dimensions**
 - Fundamental social and human dimensions are not often included in aquaculture development activities.
- **Message 2 – Transformation**
 - A transformation of the aquaculture sector is required, including a move away from business as usual towards a new human relationship with aquaculture aligned with human wellbeing concerns and greater contribution to human development goals.

- New modes of operating, for example inclusive business, need to be found, that better connect small-scale and larger scale players throughout the value chains and redress imbalances of power.
- Aquaculture is a sector of great complexity, acting on one human dimension will have impacts on others (positive and negative) because of all the interconnections that exist across social and human dimensions and across multiple players. The challenge will be to ensure an overall desirable outcome.
- **Message 3 – Human rights and equity**
 - The consideration of human rights (including labour rights), justice and equity in aquaculture should become a priority for the development of the sector in the next decade.
- **Message 4 – Certification**
 - Certification, eco-labelling, and tracing systems should be reviewed and expanded upon to better cover social and human issues, both in terms of content and process, and at more nodes in the chain because they could potentially be a key tool in helping address them if it is ensured that they are not excluding and that their impact is detrimental to smaller farmers.
- **Message 5 – Diversity of players**
 - The aquaculture sector involves a wide diversity of players (including for example women, youth, Indigenous Peoples) who need to be adequately recognised and represented in policies, guidance and analyses. Intersectionality – the consideration of how gender, race, ethnicity, age interact and intersect with other social markers such as wealth, age, religion and/or other social characteristics, is fundamental in this endeavour.
- **Message 6 – Research**
 - More research, including trans-disciplinary research, needs to be funded to fill knowledge gaps, to document human dimensions in aquaculture and propose changes to the status quo (solutions). Efforts need to be made to attract a greater number of social scientists in aquaculture research.

Thematic review 9: Value chains and market access for aquaculture products

74. The Thematic Session on *Value chains and market access for aquaculture products* was conducted on 24 September 2021 as a parallel session under Stream 3. The Thematic Session was coordinated by Junning Cai and led by Lahsen Ababouch, who is the lead author of the Thematic Review on this topic. The session presented the following salient points regarding current and future trends, challenges, and opportunities on value chains and market access for aquaculture products:

- Aquaculture production and trade has experienced significant development locally, regionally, and globally, and since 1980 aquaculture products have become one of the most globalized food commodities. This significant development and globalization have exacerbated concerns over its impacts, in particular on the environment, in different parts of the world where production development has exceeded the capacity of planning, controls and oversight.
- Over 80 percent of aquaculture production takes place in developing countries, where aquaculture commodity chains have traditionally been regulated and controlled by government institutions, with varying degrees of consultation with producers and other stakeholders. As a result of globalization and liberalization of trade, in-depth changes have occurred, impacted by the outbreak of several food and feed crises, increasing fears about food safety, spread of animal diseases, and growing concerns about the environmental and social sustainability of aquaculture. This in turn has shaped the new trade regimes for market access and driven new schemes for aquaculture value chain development and governance.
- Value chain analysis, development and governance have emerged during the last twenty years as tools to analyse and understand the dynamics at value chain nodes of key players, economic costs and benefits, value addition and value creation and to develop policy options and suitable market instruments for the promotion of sustainable aquaculture.
- Governments and development institutions such as FAO promote value chain development and governance as tools for targeting the achievement of societal goals, such as poverty alleviation, food security and gender equality. The interventions aim at upgrading the position of smallholder producers; either through financial and technical support for upgrading infrastructure, access to services and skills and practices at key nodes, or policies and efforts to improve equitable distribution of costs and benefits

and enhance market access and terms of trade for producers, workers, and other related value chain actors. However, the global aquaculture value chains have been increasingly influenced by ‘extra-chain’ actors such as standard setting and certification bodies, mainly non-governmental organizations (NGOs) or importing government institutions, and the standards and regulation that they impose on producers and processors. Because these international standards and regulations are intended to reflect the expectations of consumers that are remote in both geographical and cultural senses, they can be disconnected from the realities that prevail at the local level, neglecting or marginalizing local schemes, practices and knowledge dedicated to governing the use and management of natural aquatic resources.

- Transparent and predictable trade regimes should promote equivalence and recognition of local schemes, practices and knowledge for market access based on the internationally negotiated codes, guidelines, and standards such as the Code of Conduct for Responsible Fisheries (CCRF) and its supporting instruments.
- Aquaculture producers have raised concerns regarding the cost of certification, especially for small-scale aquaculture producers. The compliance costs associated with certification to a private standard scheme are currently borne disproportionately by those up-stream in the supply chain (including producers, processors) rather than those downstream (including retailers, food services, importers) where the demands for certification generate. Yet the most robust evidence of price premiums suggests that they accrue to the retailers who demand certification. There should be agreed mechanisms for the redistribution of these costs and benefits.
- Economic costs and benefits along the aquaculture value chains are relative to which costs are computed. Sustainable aquaculture value chains should integrate ecosystem services and social benefits in the aquaculture value chain analysis and governance. Consumer awareness and education programmes should promote consumer willingness to pay more for the real cost of the product, if the social and environmental costs were to be internalized.
- The increasing penetration of digital platforms (for example Ali Baba and Amazon) and technologies (for example blockchain) into fish and seafood trade and logistics that seek to virtualize supply chains, creating direct links between producers and consumers, the performance, structure and conduct of value chains is set to change dramatically. It is unclear, however, who will ultimately benefit from these shifts, nor whether they can foster sustainable aquaculture practices and markets for sustainability. It is important that small scale operators are considered as key operators and that local practices are not ignored and marginalized. Likewise, blockchain-based technologies offer the prospect of enhanced traceability and transparency throughout supply chains, and thus have significant potential to transform sustainability governance, food safety regulation and consumer access to information, in ways that are only just beginning to unfold.
- The concept of circular economy is emerging as a key principle for the efficient use and reuse of aquaculture waste through value chains. One conspicuous gap that requires considerably more attention is the use of aquaculture related wastes and by-product recovery.

APPENDIX I: PROGRAMME

The full programme of the GCA +20 was as follows.

Day 0: Wednesday 22 September			
Pre-conference workshop: SDG-aligned Artemia Aquaculture Moderators: Rodrigo Roubach and SUI Liying 21.00 – 22.35			
Day 1: Thursday 23 September			
Keynote Presentations			
16.30 – 17.00	Warm-up session: Video presentation – Chinese sustainable aquaculture		
Opening speeches Moderator: MA Youxiang , Vice Minister, Ministry of Agriculture and Rural Affairs of the People's Republic of China			
17.00 – 18.00	<ul style="list-style-type: none"> • QU Dongyu, Director-General, Food and Agriculture Organization of the United Nations (FAO) • H.E. TANG Renjian, Minister for Agriculture and Rural Affairs, Ministry of Agriculture and Rural Affairs of the People's Republic of China • H.E. Frank K. Tumwebaze, Minister for Agriculture, Animal Industry and Fisheries, Ministry of Agriculture, Animal Industry and Fisheries of the Republic of Uganda • H.E. Úrsula Desilú León Chempén, Vice Minister for Fisheries and Aquaculture, Ministry of Production of the Republic of Peru • H.E. Virginijus Sinkevičius, Commissioner for the Environment, Oceans and Fisheries, European Commission • HUANG Jie, Director-General, Network of Aquaculture Centres in Asia-Pacific (NACA) • PENG Chenlei, Vice Mayor of Shanghai Municipal Government 		
Keynote presentations Moderator: Jennifer Cobcroft			
18.00 – 18.30	Keynote 1: Green Development and Future of Aquaculture (TANG Qisheng)		
18.30 – 19.00	Keynote 2: Global synthesis of the state of world aquaculture (Devin Bartley)		
19.00 – 19.30	Keynote 3: The Shanghai Declaration (Matthias Halwart)		
19.30 – 21.00	<i>Dinner</i>		
Special topic presentations Moderator: Maria Celia Portella			
21.00 – 21.30	Small and medium enterprises (SME) Aquaculture: leading sector growth in sub-Saharan Africa – Harrison Charo Karisa and Lovin Kobusingye		
21.30 – 22.00	Investment in Aquaculture – Randall Brummett and Flavio Corsin		
22.00 – 22.30	Unfed Aquaculture and Integrated Multi-trophic Aquaculture: Theories and Practices in China – JIANG Zengjie		
Parallel Sessions			
	Stream 1 Thematic Reviews: 1, 2, and 3 Facilitators: Selina Stead and David Little	Stream 2 Thematic reviews: 4, 5 and 6 Facilitator: Rohana Subasinghe	Stream 3 Thematic reviews: 7, 8 and 9 Facilitator: Melanie Siggs
22.30 – 00.00	TR1: Aquaculture systems <u>Speakers/Panelists</u> Marc Verdegem (Lead) U. Win Latt Sandra Shumway Alejandro Buschmann Local moderator: <i>WANG Qingyin</i>	TR4: Aquaculture feed and feeding <u>Speakers/Panelists</u> Brett Glencross (Lead) Kangsen Mai Luisa Valente Rodrigo Roubach <u>Additional Panelist:</u> Albert Tacon Local moderator: <i>XIE Shouqi</i>	TR7: Aquaculture policies, planning and sectoral governance <u>Speakers/Panelists</u> Curtis Jolly (Co-lead) Beatrice Nyandat (Co-lead) YANG Zhengyong (Co-lead) Felipe Matias <u>Additional Panelists:</u> Ana Menezes, Neil Ridler Local moderator: <i>YANG Zhengyong</i>

Day 2: Friday 24 September			
15.00 – 17.30	South-South and Triangular Cooperation for Sustainable Aquaculture Development*		
15.00 – 16.30	TR2: Aquaculture innovation and technical solutions <u>Speakers/Panelists</u> Neil Anthony Sims (Lead) Maymyat Noelwin Alejandro Buschmann Albert Tacon Local moderator: <i>WANG Lumin</i>	TR5: AqGR and seed supply <u>Speakers/Panelists</u> Anna Sonesson (Lead) Graham Mair Eric Hallerman Fran Humphries <u>Additional Panelist:</u> Rose Basita Local moderator: <i>CHEN Songlin</i>	TR8: Social and human dimensions of aquaculture <u>Speakers/Panelists</u> Cecile Brugere (Lead) Tulika Bansal Froukje Kruijssen <u>Additional Panelists:</u> Meryl Williams, Sebastian Mathew Local moderator: <i>TANG Yi</i>
16.30 – 18.00	TR3: Transforming aquaculture to achieve SDGs <u>Speakers/Panelists</u> Max Troell (Lead) Doris Soto Selina Stead <u>Additional Panelists:</u> Anna Farmery, Richard Cottrell, Barry Costa-Pierce Local moderator: <i>XU Pao</i>	TR6: Biosecurity and aquatic animal health management <u>Speakers/Panelists</u> Victoria Alday-Sanz (Co-Lead) Rohana Subasinghe (Co-Lead) Peter de Schryver Melba Reantaso <u>Additional Panelists:</u> Patrick Sorgeloos, HUANG Jie Local moderator: <i>ZHANG Qingli</i>	TR9: Value chains and market access for aquaculture products <u>Speakers/Panelists</u> Lahsen Ababouch (Lead) Jose Fernandez Polanco Nguyen Kim Anh Mariana Toussaint <u>Additional Panelists:</u> David Vivas Eugui, Majida Maarouf Local moderator: <i>ZHU Yaping</i>
18.00 – 19.30	<i>Dinner</i>		
Poster session Moderators: Austin Stankus and ZHANG Junfang			
19.30 – 20.00	Spotlight poster presentations and awards Recognition of outstanding posters – Audun Lem (FAO)		
Shanghai Declaration Moderators: Vera Agostini and Matthias Halwart			
20.00 – 21.30	Adoption of the Shanghai Declaration – Meryl Williams / Friends of the Shanghai Declaration Statements of support for the Shanghai Declaration Guest of Honour: Her Royal Highness Princess Maha Chakri Sirindhorn, FAO Special Goodwill Ambassador for Asia and the Pacific Pledges by organizations		
Closing Ceremony Moderator: Ismahane Elouafi , Chief Scientist of FAO			
21.30 – 22.00	Maria Helena Semedo, Deputy Director-General of FAO MA Youxiang, Vice Minister, Ministry of Agriculture and Rural Affairs of the People's Republic of China HUANG Jie, Director-General of NACA		

* This High-Level Roundtable Meeting took place in parallel to the GCA +20 and attendance was by invitation only.

The full recordings of the GCA +20 can be found on the FAO webcast archives (www.fao.org/webcast) and directly with the following links.

Day 1	Plenary (link)		
	<ul style="list-style-type: none"> • Opening ceremony • Keynote speeches • Special Topic presentations 		
Day 1	Stream 1 (link)	Stream 2 (link)	Stream 3 (link)
	<ul style="list-style-type: none"> • Aquaculture systems 	<ul style="list-style-type: none"> • Aquaculture feed and feeding 	<ul style="list-style-type: none"> • Dynamics of aquaculture governance
Day 2	Stream 1 (link)	Stream 2 (link)	Stream 3 (link)
	<ul style="list-style-type: none"> • Innovation in aquaculture • Transforming aquaculture to achieve SDGs 	<ul style="list-style-type: none"> • Aquatic genetic resources and seed supply • Biosecurity: reducing the burden of disease 	<ul style="list-style-type: none"> • Social and human dimensions of aquaculture • Value chains and market access for aquaculture products
Day 2	Plenary (link)		
	<ul style="list-style-type: none"> • Poster session • Shanghai Declaration: adoption and pledges • Closing ceremony 		

APPENDIX II: OPENING STATEMENTS

Opening statement of QU Dongyu – FAO Director-General

4th Global Conference on Aquaculture, GCA +20

Speech Dr QU Dongyu – FAO Director-General at the Opening Ceremony

Excellencies,
Ladies and gentlemen,

This Global Conference on Aquaculture is the fourth one to be organized by FAO and its partners.

First, I wish to thank the Ministry of Agriculture and Rural Affairs of China and others for co-organizing this conference. These conferences are key events marking turning points in global aquaculture development.

The Shanghai Declaration on Aquaculture for Food and Sustainable Development that will be adopted by this conference is a commitment and call for action to shape the future path of aquaculture in the world. The Shanghai Conference will provide guidance on aquaculture's contributions to global agri-food systems and Sustainable Development Goals.

In line with the global commitment to the 2030 Agenda.

Aquaculture already plays an important role in “Leaving no one behind” which means all our efforts and actions must focus on everyone everywhere, in order to end hunger and poverty.

Aquaculture's contribution to agri-food systems and SDGs will continue to grow, for the following three key reasons:

First – Aquaculture provides safe, affordable, nutritious and healthy foods. Aquaculture has established its crucial role in global food security, with its production largely meeting the supply-demand gap for aquatic food over the past decades. Increased aquaculture production, improvements along its value chain, shifting consumer habits, and other socio-economic factors have contributed to doubling the average per capita consumption of aquatic foods over the past 60 years. Even though human population has more than doubled in the same period. Fish farmers in Asia have clearly shown how aquaculture can grow and supply aquatic food for an ever-growing demand.

Aquaculture is the fastest growing agri-food sector worldwide. And it is estimated that it will supply more than 60 percent of fish globally in the next decade. The experience from Asia suggests a huge potential for aquaculture to expand not only in Asia, but also in Africa, and in LAC.

Second – Aquaculture needs to focus on people, and their communities. Specifically, women, youth, children, Indigenous Peoples, the elderly, the vulnerable, the poor and the hungry. Aquaculture production will continue to grow, but the benefits of this growth must be equitable and fairly distributed. We must all perceive and promote the human, social, cultural and economic dimensions of aquaculture. Sustainable Aquaculture cannot grow in isolation – it is a key part of the global agri-food systems – and as such, it must respect and enhance sustainable development by implementing social, economic and environmental policies and practices coherently.

This brings me to my third point – Aquaculture must be efficient, inclusive, and resilient and sustainable in a holistic design. The development of the aquaculture sector must follow the principals of effective governance and up-to-date innovation. This means taking action to minimize and address negative impacts on the environment to produce more with less, eliminating conflicts with local communities with more inclusiveness, and ensuring the rights of all people. There are more blue technologies and management to be central in the new resilience for Sustainable Aquaculture. Aquaculture plays an important role in FAO's new Strategic Framework 2022–2031 as part of a Blue Transformation priority programme, with the objective of achieving

a 35 – 40 percent growth in global aquaculture by 2030. Aquaculture can also play a key role in FAO’s Hand-in-Hand Initiative to accelerate agri-food systems transformation. We are ready to strengthen global efforts through the Global Sustainable Aquaculture Advancement Partnership, between the CAFS and FAO.

Dear Colleagues and Friends,

FAO’s Strategic Framework is based on the principles of the “Four Betters”: better production, better nutrition, a better environment, and a better life for all – leaving no one behind!

The Shanghai Declaration is a call for global action.

I look forward to the solutions and suggestions from your discussions over the next few days.

Thank you.

Opening statement of H.E. Mr TANG Renjian – Minister of Agriculture and Rural Affairs of the People’s Republic of China

4th Global Conference on Aquaculture, GCA +20

Speech of H.E. Mr TANG Renjian – Minister of Agriculture and Rural Affairs of the People’s Republic of China at the Opening Ceremony

Dear Excellencies, distinguished guests, ladies, and gentlemen:

Good afternoon! The Global Conference on Aquaculture held once every ten years is one of the world's largest, highest-level fisheries and aquaculture events. The conference is hosted by China for the first time, and the international community responded extensively. More than 2 700 representatives from more than 120 countries are participating in the conference, and more than 10 ministers and heads of international organizations will make important statements. On behalf of the Ministry of Agriculture and Rural Affairs of China, I would like to extend my sincere welcome to all guests, representatives, experts, and scholars attending the conference!

Aquatic products are the third largest source of protein for human consumption and an important part of ensuring world food security. In the past 10 years, global aquaculture production has increased by more than 40 percent, becoming one of the fastest growing food production areas. It has made positive contributions to ensuring food supply, conserving aquatic environment, eliminating hunger and poverty, and promoting economic development.

The Chinese government attaches great importance to aquaculture and takes practical and effective measures to promote its high-quality development. **First, the production capacity has been steadily increasing, and aquaculture has become an important industry that guarantees supply of aquatic products.** China is the largest aquaculture country in terms of production and has been ranked first in the world for 32 consecutive years. Of the world's farmed fish, 2 out of every 3 are raised in China. In 2020, the aquaculture production reached 52.24 million tonnes, an increase of 36.4 percent compared with 2020, and the per capita share was 37 kg, twice the world average. **Second, the quality of the industry has greatly improved, and it has become a modern industry that prospers fish farmers.** Over the past 10 years, a total of 141 new aquatic species have been approved and promoted. Major breakthroughs have been made in the breeding of tilapia, river crab, kelp, and prawns. Currently, there are more than 300 aquatic species, making the country the most diversified country in the world in terms of farmed species. China also takes the lead in application of innovative technologies in the aquaculture industry such as multi-trophic level aquaculture, development and promotion of pond and factory circulating aquaculture, and deep-sea aquaculture. The contribution rate of technology reaches 36 percent.

The output value of the secondary and tertiary fisheries and aquaculture industries accounts for more than 50 percent. Last year, the per capita net income of fisher folks and fisher farmers reached 21 837 yuan. **The third is to accelerate the transformation of the aquaculture sector towards a sustainable and green industry.** The plan for zoning of aquaculture waters and tidal flats was compiled and promulgated, and 23.33 million hectares of aquaculture areas were delineated, optimizing the layout of aquaculture in offshore areas, lakes, and reservoirs, developing large-scale ecological fisheries and marine pastures, and strengthening the conservation of the ecological environment of the waters. The cultivation area of rice fish, rice shrimp, and rice crab was promoted to 2.53 million hectares, and the number of chemical fertilizers and pesticides was generally reduced by more than 30 percent compared with traditional planting methods. **Fourth, international cooperation continues to deepen, to make aquaculture an open industry that is mutually beneficial with countries from all over the world.** Aquatic products are exported to 193 countries and regions. In 2020, the import and export value reached 31.6 billion U.S. dollars. China has become the world's largest aquatic product processing and trading market. Aquaculture is also one of the areas that China extensively participates in the South-South and tripartite cooperation framework. It sent nearly 200 experts to more than 40 countries as technical consultants and trained more than 2 000 professionals for more than 50 countries.

At present, the COVID-19 pandemic is sweeping across the world, extreme weather recurring more frequently, and the number of hungry people is rising sharply. In this context, we must put aquaculture in a more important

position. Through deepening cooperation and joint efforts for all players, we will promote the development of aquatic product production, processing, distribution, and trade throughout the value chain, so that people from all over the world can enjoy sufficient, high-quality, and diverse aquatic products. Here, I would like to put forward three suggestions.

First, insist on innovation-driven aquaculture and strengthen technical support to aquaculture.

Strengthen R&D and promotion of new species, new technologies and new models of aquaculture, and promote scientific and technological exchanges and personnel training in the framework of South-South cooperation mechanism of FAO. China with FAO will jointly launch the "Global Sustainable Aquaculture Advancement Partnership (GSAAP)". All parties are welcome to actively participate in this Partnership and deepen multilateral cooperation in aquaculture research and industry.

Second, uphold green transformation and promote sustainable development.

Committed to the development of environmentally friendly aquaculture, improve facilities and equipment, and increase standards of sewage discharged from aquaculture, give full play to the role of shell algae cultivation in helping carbon neutrality. China is willing to actively share experience in the transformation and development of aquaculture, promote mature technology models such as integrated rice-fishing and ecological pond farming, and with countries around the world to jointly improve the sustainable development of global aquaculture.

Third, adhere to the principle of mutual benefit and expand trade and investment.

Facilitate mutual recognition of inspections and the quarantine standards and the traceability systems with various countries, reduce unreasonable import and export restrictions, and build a smooth and mutually beneficial international industry chain and supply chain to make aquatic product trade and investment more convenient.

Thank you!

Opening statement of H.E. Mr Frank K. Tumwebaze, Minister for Agriculture, Animal Industry and Fisheries, Ministry of Agriculture, Animal Industry and Fisheries of the Republic of Uganda

4th Global Conference on Aquaculture, GCA +20

Speech of H.E. Mr Frank K. Tumwebaze, Minister for Agriculture, Animal Industry and Fisheries, Ministry of Agriculture, Animal Industry and Fisheries of the Republic of Uganda at the Opening Ceremony

Your Excellency, Dr QU Dongyu, Director-General of the Food Agriculture Organization of the United Nations,

Your Excellency, Dr TANG Renjian, the Minister of Agricultural and Rural Affairs of the People's Republic of China,

Your Excellency, Mr LI Qiang, the Secretary of Shanghai Municipal Committee of the Communist Party of China, CPC

Honourable Ministers and Vice Ministers, diplomatic envoys,

Ladies and gentlemen,

Greetings to you from his Excellency Mr Museveni, the President of Uganda

I also bring all of you warm greetings from the people of Uganda.

Uganda is the heart of Africa and I invite you to visit Uganda and experience the warmth of our land and of our people.

We are connected here today from different continents and cultures, for aquaculture for food and sustainable development, the true representation of the reason of FAO of the United Nations and the Network of Aquaculture Centres in the Asia Pacific, with the Chinese Ministry of Agriculture and Rural Affairs, to bring stakeholders from government, business, academia, and civil society together to identify policy and technology innovations, investment opportunities, and fruitful areas of cooperation.

Fish and other aquatic products can and will play a major role in meeting the dietary and food security demands of all people. Coordinated and accelerated actions, therefore, to engage farmers, food processors, traders, researchers, technical experts, and leaders the world over to address issues of market access, competitiveness, communication gaps, experience and information sharing, and training of personnel of the aquaculture sector will foster sustainable development. In this context, the role of national, regional, and international cooperation cannot be over emphasized. Therefore, this interaction is welcome.

Uganda produces up to 100 000 tonnes of fish annually from small scale fish farmers, from emerging commercial fish farmers and stocked community water reservoirs and minor lakes. Aquaculture production in Uganda has been growing steadily at an annual rate of 30 percent over the last 10 years. Where aquaculture has significant potential to contribute to our mission for steady economic growth and poverty reduction as per SDG 1, ending hunger and all forms of malnutrition which is SDG2.

The yields in sub-Saharan Africa remain very low compared to global averages due to several challenges. These challenges are in areas of feed, seed quality, production systems, knowledge and technical skills that require us to harness the power of science, technology and innovation to transform aquaculture, sustainably increase our production levels, to feed ourselves and to feed the region, and the global markets and generate incomes for people's livelihoods.

Uganda and Africa at large have been for a long time looking for a partner, who comes in a mutually beneficial partnership that can help Africa transform its aquaculture to be a force of food security and income generation and enhanced economic growth. Our hope is that the South-South conference in the field of sustainable agriculture will be an enabler in this course. In the pursuance of goals and objectives, however, the emphasis

should be put also following a sustainable approach through green development, integrated efforts for profitable aquaculture and FAO's Hand in Hand Initiative.

I also take this opportunity on behalf of the Government of Uganda and the people of Uganda, to invite you through your governments, investors in this sector, the potential of fish maw is unexploited in Uganda. This is an area where investors can come and exploit and be able to set up factories of threads used in the [medical] theatres. Therefore, this is an area you can have a very, very good, competitive advantage. If you come and invested in our aquaculture sector.

In Africa, we say if you want to go fast, go alone, if you want to go far, go together; so with this and more cooperation and support, the growth and sustained development in the aquaculture sector it is said to go both faster and far.

I thank you for listening to me, your Excellencies.

Opening statement of H.E. Ms Úrsula Desilú León Chempén, Vice Minister for Fisheries and Aquaculture, Ministry of Production of the Republic of Peru

4th Global Conference on Aquaculture, GCA +20

Speech of H.E. Ms Úrsula Desilú León Chempén, Vice Minister for Fisheries and Aquaculture, Ministry of Production of the Republic of Peru

NB: speech presented in Spanish; the following text is a transcript of the English interpretation

Distinguished guests, delegates, colleagues, ladies and gentlemen,

The Global Conference on Aquaculture +20 this year features the theme “Aquaculture for food and sustainable development” and this is an event that has brought together representatives of governments, businesses, academia and civil society whose task it is to identify the policies and innovative technologies, the opportunities for investments, and areas of cooperation in aquaculture.

Before I present you with the advances made by Peru in this area, I would like to reflect on the current crisis brought about by COVID-19 which has consequences that are disproportionate in the low income, vulnerable households in particular in developing countries where unemployment has soared considerably and where the networks of food security are rather scant and it is therefore necessary to strengthen certain areas of productive development like aquaculture, and foster a system of trade that will be sustainable, fair and inclusive, in order to maximize the positive contribution to the recovery after the crisis.

Now, of course, bold measures will be required on the part of national governments as well as the global community that will enable people to enjoy access to safe and healthy food. And this means that we are going to have to redirect our efforts in order to achieve the SDGs 2030.

The declaration in favour of sustainable fisheries and aquaculture that was approved at the Thirty-fourth Session of the Committee on Fisheries of FAO in February of this year, had the goal of recognizing the achievements made in this sector since the approval of the Code of Conduct for Sustainable Fisheries. Moreover, it highlights the huge potential for growth of aquaculture for many regions, in particular, if we do adopt innovative measures that will guarantee environmental management as well as benefits of inclusive sustainable development programmes, with a special focus on the regions whose population growth will pose greater problems to food systems.

In this context, Peru has prioritized the development of sustainable aquaculture and we are right now defining instruments that will make it possible to strengthen this growth as a source that will generate food, employment, jobs and currency for the country. In this context, we have developed a national aquaculture policy with a broad public and private participatory process, and the support of FAO in the first phase of its formulation.

With this national policy we will contribute to a sustainable, competitive and resilient aquaculture. Thus, we have felt it necessary to strengthen the competitiveness and sustainability of small-scale aquaculture practitioners, because they account for 98 percent of the total users, and most of them just don't have enough capacities, skills, or they have unmet technological needs. With the support of FAO, we have developed the national aquaculture strategy that will make it possible to build and strengthen capacities and skills for small-scale practitioners, with the focus on self-management, empowerment and sustainable development.

We have also created the first certification standard called “sustainable aquaculture” and this in order to promote development in this industry and keeping with the conservation of environmental resources. Equally, technological development and innovation are very important pillars on our way to sustainable development. This is why, through the national programme of innovation in fisheries and aquaculture, we finance small-, medium- and large-scale producers, who are interested in innovating in the sector with a sustainable approach. Finally, I wish to express the recognition or the acknowledgement and gratitude of Peru, on its bicentenary, to FAO, to the Network of Aquaculture Centres in Asia Pacific, and to the Ministry for Agriculture and Rural Affairs of China, for organizing this Global Conference on Aquaculture Millennium +20.

Thank you.

Opening statement of H.E. Mr Virginijus Sinkevičius, Commissioner for the Environment, Oceans and Fisheries, European Commission

4th Global Conference on Aquaculture, GCA +20

Speech of H.E. Mr Virginijus Sinkevičius, Commissioner for the Environment, Oceans and Fisheries, European Commission at the Opening Ceremony

I'm very pleased to have been offered the opportunity to address this meeting. Ladies and gentlemen, I'm very pleased to have been offered the opportunity to address the distinguished audience today for this video message. I would have wish to have the opportunity to meet in person with other speakers and participants in this conference that only takes place every ten years. I am particularly pleased to address this message to you since the European Commission adopted before the summer a new strategy for the future development of the aquaculture sector in the European Union in this decade.

Even if the strategy takes into consideration the reality of aquaculture in Europe, it addresses many of the issues that are common to the development of aquaculture more globally. We all know that we have little time to bring in the radical transformation that we need in order to achieve the goals of the 2030 Agenda and the Sustainable Development Goals.

The next ten years will also be crucial in addressing the impact of the climate crisis and avoid your immediate damage to the environment. Taking immediate and decisive action to build more sustainable food systems is an essential part of that transformation.

This is what world leaders and stakeholders are discussing today at the UN food system summit. Fortunately, they need to ensure sustainable and resilient aquatic food systems for the necessary transformation of global food systems is increasingly recognized.

Aquatic food production needs to be part of the solution. This will require sustainable fisheries, but a significant increase in aquatic food production will have to rely mostly on aquaculture growth. The continued and sustainable growth of aquaculture is therefore part of what is needed to achieve the UN sustainable development goals.

Aquaculture will manage in a sustainable manner and offer an enormous potential to contribute to the big challenges that we face today. Aquaculture can be a source of nutritious food with lower carbon and environment and footprint that other forms of food production. It also has a broad potential for the diversification and growth, for example, we need very little input to grow. Despite this, their big potential to support global nutritional security is largely unexplored.

Aquaculture also has a big potential to create new economic activity and sources of income when synergies with other activities and industries are developed. We have seen in many countries, the benefits that the combination of farming of fish and rice can offer in terms of food, security, and livelihood. Using algae or other by products of aquaculture for other industries, such as feed, pharmaceuticals or fertilizers can also offer new opportunities.

Some forms of aquaculture production also offer important ecosystem services and contribute to climate change, mitigation, and adaptation. The EU agenda for green growth and the EU strategy towards sustainable food systems called the farm to fork strategy, recognizes the potential of aquaculture and calls for an accelerated shift toward sustainable fish and seafood production.

The new strategy for EU aquaculture aims at implementing that shift. For aquaculture to live up to its promise, we need to ensure that the global development of agricultural production and the value change is more equitable and sustainable.

We all know that our help is inextricably linked to that of our plan. Aquaculture growth needs to be done in a way that is environmentally sustainable in order to ensure that it is part of the solution and not of the problem.

We also need to ensure that aquaculture provides food, security, and nutrition to all and provide a source of income to those most of them. This requires clear strategies and effective and coherent policy, but also strengthen partnership among different stakeholders. Public authorities, aquaculture producers, NGOs, researchers, investors, citizens, and consumers. We all have our role to play.

The teams being discussed at this conference are all very relevant for the Challenge ahead for global local culture. I hope that this conference will inspire all relevant actors to adopt concrete and actionable solutions to ensure that the development of global aquaculture in the present decade contributes to the achievement of the 2030 SDGs supporting this sustainable path is part of the commitments of the European green deal and the farm to foreign strategy of the European Union.

In terms of concrete steps, at global level, I would like to stress the importance of further progress towards the development of comprehensive and ambitious, ethereal guidance for sustainable aquaculture, which we hope will see the light in 2022. The EU will continue its contribution to the valuable work of the FAO in developing these guidelines and its cooperation with developing countries.

I am by wishing all participants a rich and fruitful discussions and thanking the host and organizers of this conference for their efforts.

Thank you.

Opening statement of Dr HUANG Jie, Director of the Network of Aquaculture Centres of Asia-Pacific

4th Global Conference on Aquaculture, GCA +20

Speech of Dr HUANG Jie, Director of the Network of Aquaculture Centres of Asia-Pacific (NACA) at the Opening Ceremony

Thank you, Vice Minister MA.

Your Excellencies, Director-General Qu, Minister Tang, Minister Tumwebaze, Vice Minister Chempén, Commissioner Sinkevičius, Vice Mayor Peng, distinguished speakers, panelists, audiences, ladies, and gentlemen, good evening, good morning, and good afternoon.

Representing the Network of Aquaculture Centres in Asia-Pacific and as one of co-chairs of the International Organizing Committee of the conference, I'm delighted to take this great honor to welcome all of you to the Global Conference on Aquaculture Millennium +20.

NACA sincerely appreciates FAO and the Ministry of Agriculture and Rural Affairs of China for co-organizing the GCA +20. As Vice Minister MA introduced, NACA has been involved in the co-organization of this conference and the previous two conferences. NACA was born and developed along with the series of Global Conferences on Aquaculture.

In 1976, FAO held the first event of this conference series, the FAO Technical Conference on Aquaculture, in Kyoto, Japan. The Kyoto Strategy for Aquaculture Development announced that aquaculture was transforming from a traditional to a science-based economic activity. Furthermore, the strategy promoted aquaculture technical cooperation among developing countries. FAO and the United Nations Development Programme, therefore, started a project with the same name of NACA in the year of the conference to promote technical cooperation in aquaculture in Asia-Pacific. Through two rounds of the project, participating countries have experienced significant benefits in aquaculture development. Therefore, under the mediation of FAO, governments signed the NACA Agreement and formally empowered NACA as a regional intergovernmental organization in 1990. NACA is proud to subsequently work with FAO and the Thai government to co-organize the second and third previous Global Conferences on Aquaculture in 2000 and 2010. As the outputs from the conferences, the Bangkok Declaration and the Phuket Consensus further demonstrated the promoting role of regional and global cooperation for aquaculture development.

Over the last three decades, in cooperation with member governments and international organizations such as FAO, NACA has assisted members in developing sustainable aquaculture to alleviate poverty, enhance food security, maintain the integrity of national resources and the environment, and respond to emergencies such as climate change, emerging diseases, and the impacts of COVID-19. Furthermore, the network has cultivated a large pool of aquaculture human resources for developing countries in the region. From 1976 to 2019, the regional aquaculture production in Asia and the Pacific increased more than 23 times, with an average annual growth rate of 7.6 percent in 43 years.

As remarked by FAO Director-General and distinguished speakers, aquaculture in the coming decade faces the challenges of sustainable development and coordination with the agri-food system to supply more than 60 percent of the global demand for aquatic products and maintain equitable growth and fair distribution. The conference will take on a key event in finding solutions to the challenges and play its role in achieving the 2030 SDG of the United Nations. NACA expects that the outputs of the conference will chart the course for meeting the challenges.

Again, taking this opportunity, NACA sincerely thanks the cooperation from the co-organizers of the conference and the supports from FAO, member governments, partners, and aquaculture stakeholders. I'm looking forward to the complete success of the conference.

Thank you.

Opening statement of PENG Shenlei, Deputy Mayor of Shanghai

4th Global Conference on Aquaculture, GCA +20

Speech of Peng Shenlei, Deputy Mayor of Shanghai at the Opening Ceremony

Dear Director-General QU Dongyu, Director-General HUANG Jie, Deputy Minister MA Youxiang, and Deputy Director LI Chunsheng, guests and friends.

First of all, on behalf of the Shanghai Municipal People's Government, I would like to extend my warm congratulations to the convening of the 4th Global Aquaculture Conference! A warm welcome to the guests at home and abroad who participated in the conference! I would like to express my sincere thanks to people from all walks of life who have cared about and supported the development of Shanghai for a long time!

With the continuous increase of the world population and the continuous improvement of living standards, people's demand for aquatic products will continue to increase, and natural fishery resources are becoming increasingly tense, which will inevitably make the future development of fishery and the supply of aquatic products rely mainly on aquaculture. I believe that the convening of this conference will condense the wisdom of insights from all over the world and contribute to the promotion of the sustainable development of the global aquaculture industry, the acceleration of international trade in aquatic products and the integration of global elements, the realization of complementary advantages and win-win cooperation, and more Play a positive role in benefiting the people of the world.

Shanghai is a modern international metropolis born and prospered by water. In recent years, Shanghai has actively built an aquaculture system that is compatible with the mega-cities, and aquaculture has become a characteristic industry of Shanghai's agriculture.

We will use this conference as an opportunity to further strengthen our close ties with international organizations such as the United Nations Food and Agriculture Organization, deepen international cooperation and exchanges in the aquatic field, and continue to improve scientific and technological innovation capabilities and levels, so as to contribute to the high-quality and green development of global aquaculture contribution.

Finally, I wish this Global Aquaculture Conference a complete success!

Thank you all.

APPENDIX III: Statement of Her Royal Highness Princess MAHA CHAKRI SIRINDHORN at Session "Adoption of Shanghai Declaration, Pledges and Statements of Support by Organizations" in the Global Conference on Aquaculture Millennium +20, Shanghai, China, 24 September 2021

I am honoured to be invited to virtually deliver a statement at the Global Conference on Aquaculture Millennium +20, organized in Shanghai. Aquaculture or aquafarming in Thailand, and in many other countries, is a very important mechanism to procure food security. It has contributed to an increase of food intake especially protein intake of our population. It also has a great impact on increasing the national income from exporting aquaculture products. We have both freshwater and saltwater aquaculture, including breeding of fish, shellfish, algae, crabs, lobsters, shrimps and Artemia, or brine shrimp for fish feeding, *et cetera*.

Apart from aquatic animals, aquaculture also promotes breeding of aquatic plants. In Thailand we grow water plants, like lotus and water lilies. Both are decorative plants. Lotus is used in religious ceremonies, and lotus seeds, petals and roots are well known in Thai cooking. Some are herbal medicines. Waterlilies stems can also be used in Thai cooking.

Hydroponics can also contribute to aquaculture. We grow plants in water without using soil. Instead of soil we add plant nutrients in the water, but we must be careful not to overuse artificial chemicals. When I grow hydroponic plants, I use farm animal droppings or dungs instead of chemicals, as I have chosen to buy dung from organic farms.

It has been over 40 years that I have worked on education and nutrition, especially in schools and communities in the remote areas of Thailand and in other countries, and I must say that aquaculture has been an important tool in my project. Food from aquaculture is usually nutritious and inexpensive, and so it can be a good food source for all. In fact, most communities are already familiar with aquaculture. We can just lend them a hand to help improve breeding, feeding, harvesting, and processing those aquatic species, turning them into nutritious food and also valuable products for sale. For this reason, I have fully adopted aquaculture as a solution to achieve the goal of "Good Food for All".

In an international conference like this one, there are many stakeholders from various governments and civil societies, coming together to brainstorm for the solutions for global food and nutrition security. May I express my support of aquaculture as a "Global Solution" to reach Sustainable Development Goal #2: Zero Hunger, to save the peoples of the world threatened by pandemic, climate change, environmental degradation, and frequent natural calamity.

Thank you very much.

APPENDIX IV: CLOSING STATEMENTS

Closing statement of Maria Helena Semedo, FAO Deputy Director-General

4th Global Conference on Aquaculture, GCA +20

Speech of Maria Helena Semedo, FAO Deputy Director-General at the Closing Ceremony (24 September 2021)

Excellencies,

Ladies and gentlemen,

The 2030 Agenda for Sustainable Development is our global blueprint to transform our world.

A world without hunger. A world without poverty. A world we are proud to pass on to our children. Food systems have a huge part to play in sustainable development. Aquaculture is a major component of the global food system, aquaculture systems can and must play a larger role in combatting and overcoming poverty, hunger, and malnutrition.

Because most of the sustainable development goals and many associated targets are relevant to aquaculture development.

We know future supplies and consumption of fish and fish products will be based mainly from aquaculture. With your support and commitment for tomorrow's sustainable development, aquaculture will play its key role in transforming our agri-food systems and achieving our sustainable development vision.

Over the last two days, we saw the diversity of global aquaculture and of people involved in aquaculture – and the range of topics to be considered to enable aquaculture to reach its potential. We highlighted the need for innovations and the means and ways to deliver and transfer new and good technology and good practices and recognized the importance of participatory extension as a vehicle help farmers adopt new technology or good practices. We underscored the need for investments in sustainable aquaculture, to access capital and to align financing flows and policies with economic, social, and environmental priorities.

And we talked about policy and governance: Aquaculture needs to be integrated in the wider food systems strategies, global policy processes and national and regional frameworks.

No doubt will partnerships be crucial for the implementation of the Shanghai Declaration for sustainable aquaculture development. Exchange, collaboration, and coordination should engage regional aquaculture networks, professional societies, aquaculture R&D initiatives, value chain actors, civil society organizations, inter-government agencies; we must work together.

FAO's Hand-in-Hand Initiative is a powerful example of this collaboration. We will deliver tangible benefits for sustainable aquaculture development, exchanging experiences between countries with strong aquaculture development and less aquaculture developed countries. Targeted and effective action on the ground, and support to farmers, their families and communities should help small producers particularly in Africa, LAC, and SIDS.

We are ready to strengthen global efforts through the Global Sustainable Aquaculture Advancement Partnership, between the CAFS and FAO.

I end my speech with a request to each of you, all of you. Please do your part to enable aquaculture to develop sustainably. Share the benefits widely. Generate opportunities for jobs and employment and wealth, and provide these opportunities for all people: women, men, and youth. Produce good, safe, and healthy food, and *nourish* your communities. And leave no one behind!

You have already started, by adopting the **Shanghai Declaration on Aquaculture for Food and Sustainable Development**. We all hope this Declaration will guide stakeholders worldwide in their efforts and initiatives to achieve the SDGs and more sustainable aquaculture practices through sustainable and people-centred aquaculture development.

Let Shanghai be our new starting point, let's keep together, let's work together and let's transform aquaculture to be part of more efficient, inclusive, resilient, and sustainable agri-food systems under the four betters – Better Production, Better Nutrition, a Better Environment, and a Better Life.

Thank you again for your participation and contributions.

Closing statement of H.E. Mr MA Youxiang, Vice Minister of the Ministry of Agriculture and Rural Affairs of the People's Republic of China

4th Global Conference on Aquaculture, GCA +20

Speech of MA Youxiang, Vice Minister of the Ministry of Agriculture and Rural Affairs of the People's Republic of China at the Closing Ceremony (24 September 2021)

Dear Ms Maria Helena Semedo, Deputy Director-General of the Food and Agriculture Organization of the United Nations,

Dear Mr HUANG Jie, Director-General of the Network of the Aquaculture Centres of Asia-Pacific,

Distinguished guests participating online and offline, ladies and gentlemen.

With the joint efforts of all parties, the 4th Global Aquaculture Conference successfully completed its agenda. Over the past two days, representatives of 120 countries, regions and economies around the world have explored the development direction of global aquaculture, jointly promoted practical cooperation in aquaculture, and jointly imagined the limitlessness of aquaculture, focusing on the opportunities, problems, challenges, and future of global aquaculture. In the future, many valuable and constructive suggestions made are the crystallization of the hard work and wisdom of all the participants. There is a confidant in the sea, and the end of the world is close to each other. Although we are separated by thousands of mountains and rivers because of the epidemic, the future of global aquaculture will connect us together, and we will always be one family.

The "**Shanghai Declaration**" just adopted reflects the results of this conference and depicts a beautiful blueprint for global aquaculture in the post-epidemic era.

It marks the beginning of a new stage in the global aquaculture industry. During the conference, the "South-South and Tripartite Cooperation High-end Roundtable Conference on Promoting Sustainable Aquaculture Development" sponsored by the Ministry of Agriculture and Rural Affairs and the "Initiative on Promoting the Sustainable Development of South-South and Tripartite Aquaculture Cooperation" was launched and received positive responses and extensive support from all parties involved. It can be said that this conference is a successful conference that can be included in the development of world aquaculture.

At present, the epidemic is not over yet, and the fight against the epidemic is still continuing. But we believe that with the joint efforts of all mankind, the epidemic will be overcome. We are willing to stand at a new starting point with countries all over the world, implement the various initiatives of the "Shanghai Declaration", join hands to promote the sustainable development of the global aquaculture industry, and contribute to ensuring global food security and building a community with a shared future for mankind!

Thank you all!

Closing statement of Dr HUANG Jie, Director-General of NACA

4th Global Conference on Aquaculture, GCA +20

Speech of Dr HUANG Jie, Director-General of NACA at the Closing Ceremony (24 September 2021)

Thanks, FAO Chief Scientist Madame Ismahane Elouafi,
Your Excellencies, Deputy Director-General Semedo, Vice Minister MA, distinguished guests, experts,
audience, ladies, and gentlemen,

Good evening, good morning, and good afternoon.

I'm honoured to take this opportunity to express our appreciation and congratulations to all of you, on behalf of NACA and as one of the IOC co-chairs.

After two days of intensive agenda, our conference is drawing to a close. As you see, the COVID-19 pandemic caused the conference to be postponed for one year and held in a hybrid model. Meanwhile, the duration of the conference was shortened to two days. However, with all your supports, we finally obtained fruitful outputs through the intense programme of the conference. FAO Director-General and Ministers put forward expectations for aquaculture development. Keynote speakers pointed out the direction for the sustainable development of aquaculture in the world. Speakers of the special topic presentations introduced innovations and development modes with regional characteristics. Parallel sessions brilliantly summarized the development of aquaculture-related 9 thematic topics. We also received a large number of excellent posters from all around the world.

Most importantly, the conference adopted the Shanghai Declaration and received support statements from Her Highness Princess Maha Chakri Sirindhorn, the FAO Special Goodwill Ambassador for Asia and the Pacific, and pledges of organizations. The Shanghai Declaration will be an epoch-making declaration. It provides an essential strategy for promoting the sustainable development of global aquaculture and the blue transformation of food systems in the coming decade. NACA is delighted with the success of the conference and honoured to be a part of it.

Chinese has an old phrase to describe the effect of perseverance called 十年磨一剑 "a decade of grinding sword". The decade aquaculture development is like the grinding effort. Aquaculture-related governments, organizations, professionals, practitioners, and other stakeholders worldwide are like the sword owners. Likewise, the GCA +20 is the sword handle. As a result, the Shanghai Declaration is the sharpened sword. The lights from the glittering sword not only shine the development achievements in the past decade but also reflect the development direction for the coming decade.

Over the past three years, I have seen the colleagues of four committees and all cooperative organizations devote themselves to the conference preparation. Congratulations! Your efforts have finally come to great success. I want to express my sincere thanks to all members of the International Organization Committee, the International Programme Committee, the Local Organization Committee, the Shanghai Declaration Drafting Committee, distinguished guests, keynote speakers, special topic speakers, and the regional and thematic reviews panellists for their excellent contributions. I also want to express my special thanks to the cooperation and continuous supports from conference co-chairs Liu Xinzong and Matthias Halwart, colleagues from FAO, the Ministry of Agriculture and Rural Affairs of China, SHOU, the China Society of Fisheries. Furthermore, I would extend my thanks to the strong supports from the Bureau of Fisheries of MARA of China, the local administration and agricultural committee of Shanghai city, the CAFS, the National Fisheries Technology Extension Centre, CAPPMA, and other partners in Shanghai. Finally, I'm grateful for the participation of all the attendees online and in-person from around the world!

NACA is looking forward to working with you in the future.

I wish you a relaxed and happy weekend!

Appendix V: Abstracts of keynote presentations

Abstract of keynote speech 1: Sustainability of aquaculture in China: Past and Future – TANG Qisheng

After more than half a century of persistent efforts, China's aquaculture has delivered spectacular results, thanks to the strong driver mainly including advanced mental preparation, solid scientific and technological support, correct development decisions, and clear development concepts. Green and high-quality development, namely sustainable development in the era, represents both the present and the future of China's fisheries. The most important thing is to build an environment-friendly aquaculture and implement a farming carrying capacity planning and management system. Addressing the contradiction between aquaculture development and ecological environment protection is a very difficult management and scientific task, and it is of great urgency to establish an assessment system for regional carrying capacity in aquaculture, establish a management system for carrying capacity in aquaculture, develop ecological and healthy new production modes, improve the mechanization, information and intelligence levels of large-scale aquaculture, and improve the law enforcement over aquaculture governance.

Abstract of keynote speech 2: Global synthesis of the state of world aquaculture – Devin Bartley

This presentation synthesizes six regional reviews and other information from FAO to examine how the aquaculture sector has performed in the past and what lessons might be learned for the future. The world's capture fisheries have plateaued at about 90 Mt; therefore, aquaculture is expected to be the major source of new aquatic food. 2018, the last year complete data are available, was a record year for aquaculture with over 114.5 metric tonnes produced valued at about USD 263.6 billion. One of the main reasons for this high production is the tremendous diversity of the sector. About 466 species or species items composed of fish, molluscs, crustaceans, echinoderms, vascular plants, seaweeds, and micro-organisms were farmed in a variety of systems and environments from tropical rice fields to sub-arctic fjords. The sector is innovating in regard to disease diagnosis and treatment, genetic technologies, system technology for example the Recirculating Aquaculture System (RAS), aquaponics and the Integrated Multitrophic Aquaculture (IMTA), and digital technologies. The regional reviews demonstrated that the sector is not homogenous among regions: Asia and developing countries continue to dominate global production, but even within regions there are vast differences in the development of the sector. Aquaculture is striving toward improved environmental sustainability. The sector is an efficient use of fish in aquafeeds, using about 5 Mt of wild fish over the past several decades while over-all production has increased dramatically.

Ecolabelling and certification have been developed to promote sustainability, but more is needed specially to ensure they do not become trade barriers for small-scale producers. Over 20 million people are employed in the sector that provides jobs in areas where other forms of employment are limited. Seafood remains one of the world's largest traded commodities and again the reviews revealed regional differences: the Near East and North Africa and sub-Saharan Africa regions market fish fresh with little processing or value adding while other regions trade a variety of fish and fish products; many developed areas cannot meet their demand for fish and must import large quantities. All regions reported that trade statistics are incomplete and usually do not differentiate farmed from captured products. External factors continue to impact aquaculture development. The COVID-19 pandemic and other large-scale environmental hazards revealed that the sector needs to improve disaster preparedness. The SDGs have prompted new ways of promoting and analysing food systems that look beyond tonnes produced and focus instead on positive outcomes for local communities in the form of nutrition, livelihood, and food security. Aquaculture contributes to nearly all of the SDGs, and each region has opportunities, advantages and challenges in implementing these global goals.

Abstract of keynote speech 3: The Shanghai Declaration – Matthias Halwart

The GCA +20 continues the tradition of several global conferences on aquaculture organized by FAO and NACA at the request of their members. Starting with the FAO Technical Conference on Aquaculture in Kyoto (1976) and reconvened by FAO and NACA in Bangkok (2000) and Phuket (2010), the GCA +20, hosted by the Chinese Ministry of Agriculture and Rural Affairs in Shanghai, the People's Republic of China, brings together a wide range of experts and important stakeholders to discuss the theme “Aquaculture for Food and Sustainable Development”.

As was the case for previous conferences, the GCA +20 culminates with the adoption of a declaration that was prepared by its participants. This time, due to the limitations of a hybrid conference, the Shanghai Declaration was developed ahead of the GCA +20 over the course of two years in a broad, inclusive, and transparent participatory process with a wide range of stakeholders from governments and intergovernmental organizations, private sector, academia, and civil society. In parallel to this bottom-up approach, six Regional Reviews and a Global Synthesis as well as nine Thematic Reviews on aquaculture were prepared, all of which serve as the scientific and technical foundation for the declaration. Following many rounds of consultations, the GCA +20 participants identified a shared vision, five overarching commitments, and ten strategic priorities serving to enhance the contribution aquaculture to the SDGs. A sustainable aquaculture sector, in all dimensions, will also help transform the global food system into one that fully appreciates and incorporates the role of diverse and nutritious farmed aquatic foods and their value chains. Outlined within the Shanghai Declaration, a Call for Action explicitly elaborates guiding actions to be taken when operationalizing the strategic priorities in the future.

The participants elaborated the Shanghai Declaration with the aspiration that it may serve all stakeholders, and in particular planners, policy, and decision makers, as a timely and urgent reminder for strengthened and accelerated development of aquaculture, and act as a compass pointing to the specific and concrete actions needed for the aquaculture sector to develop in a sustainable manner.

Given the original request for the GCA +20, its findings and outputs will be presented to the Members of FAO and NACA through the appropriate fora, for information and further consultation, with the distinct goal for the Shanghai Declaration to strengthen governance mechanisms as well as advance the development of sustainable aquaculture and its contribution to the SDGs at global, regional, and national levels.

APPENDIX VI: ABSTRACTS OF SPECIAL TOPIC PRESENTATIONS

Abstract of the special topic presentation 1: Small and medium scale aquaculture – leading sector growth in sub-Saharan Africa by Harrison Charo Karisa and Lovin Kobusingye

Aquaculture production stands at 82 million tonnes globally and has been the fastest-growing segment of agriculture, increasing at a rate of 7.5 percent per annum since the 1970s. Currently, small, and medium-scale producers from developing countries produce most of the farmed fish. Although Africa contributes only 7 percent of current global aquaculture production, recent decades have seen rising growth fuelled by SMEs. Initially dependent on public investment and donor funds, the private sector has invested a considerable amount into aquaculture development over the years.

The subsistence mentality that gripped most African aquaculture at inception is waning, and, in its place, a commercial mind-set that spurred an entrepreneurial environment. As a result, several countries in sub-Saharan Africa have recorded steady growth in aquaculture production. Bottlenecks exist in the form of poor access to credit, lack of technical know-how among farmers, poor access to quality inputs such as genetically improved seed, quality feed, high cost of production, losses of produce due to poor infrastructure in the rural areas, and marketing challenges.

Fish feeds take up to 70 percent of fish farmer's production costs and is a major constraint to fish farming in resource poor regions. The high cost of fish meal has led to a search for alternative sources including animal and plant-based ingredients. SMEs using new technologies that utilize food wastes and by-products to produce insect-based meal are growing in number across the continent giving hope to local solutions to the feed problem. Some SMEs have introduced new fish products including fish sausages, samosas which is promising to expand the consumer base among non-traditional fish consumers.

A market-focused investment model with more significant profit-making motivation is proposed. Aquaculture cooperatives can bargain for affordable credit, lobby for conducive government policies, enhance specialization among members, assure better technical assistance through novel extension methods, and can find and sustain new markets that fetch better prices for fish and fish products through bulk marketing. Growing use of mobile telephony across the continent has made it easier to disseminate market information and technical knowledge among actors across the value chain. The cooperatives are expected to facilitate economies of scale to support efficiently run genetic improvement programmes for quality seed and purchase of other quality inputs. In addition, support from a continent-wide Aquaculture Innovation Platform with national or regional connections will ensure no one is left behind. The goal is to support home-grown solutions to most of the challenges facing farmers and spur the aquaculture supply chain's growth in developing countries.

Abstract of the special topic presentation 2: Investment in aquaculture by Randall Brummett and Flavio Corsin

Public Sector Investment in Aquaculture

Real potential for long term economic growth and job creation in many developing countries exists in the seafood industry, for which infrastructure such as roads, cold storage and processing capacity already exist and could be expanded but for the lack of reliable supply that capture fisheries cannot sustainably generate. According to Organisation for Economic Co-operation and Development and World Bank estimates, seafood supply (especially of reasonably priced whitefish for lower- and middle-income consumers) is far from satisfying demand. In response to these market opportunities, over the last 30 years aquaculture has grown to produce over half of global seafood, but like agriculture generally, faces its own sustainability issues.

The ultimate driver of unsustainability in aquaculture is the lack of finance to adopt Best Practices. Globally, aquaculture is a medium scale business (net present value of USD 3–5 million in Africa; smaller in Asia where temperatures are generally higher, there is more water, and infrastructure is more suitable). Because it is mostly local businesses that operate idiosyncratic and often ad hoc production systems, they periodically suffer large losses that make commercial banks reluctant to lend. Consequently, over 90 percent of finance for aquaculture comes from personal savings, meaning that virtually all farms are under-capitalized. Cutting corners by buying less efficient technology and externalizing environmental costs are ways to save money but increase risk at a variety of levels. The industry thus finds itself in a “chicken-or-egg” conundrum where the industry cannot access the finance it needs to reduce risk and environmental impacts, because of its high-risk profile among financiers.

Public sector investment in the aquaculture sub-sector focuses on breaking this conundrum by lowering the cost of capital so that medium-scale farmers can increase their application of Best Practices to release the potential for growth in the seafood industry so that it can continue to modernize and reduce economic pressure to overfish natural resources. The implementation of Best Aquaculture Practices would reduce and manage risk to that these farms become:

1. More profitable at a smaller scale to encourage SME investors first entry into a growing industry
2. Make these farms bankable so they can grow to meet demand and create new technology and markets

In the absence of systematic public sector engagement, the history of aquaculture will be repeated, for better or worse. Market demand is growing, and sustainable capture fisheries are yet a dream in most places. Aquaculture producers respond to market and price signals just like everyone else and, in the absence of sustainable and affordable alternatives, will cut corners and incur the wrath of Mother Nature. If best practices are eventually mandated by law to minimize these negative externalities, only wealthy corporate investors will remain economically viable, able to respond to consumer demands for affordable, quality seafood while respecting environmental safeguards. To level the playing field and create opportunities for the smaller scale operations that are the engines of growth in most economies, best practices need to be made available, a clear role for government financing.

Abstract of the special topic presentation 3: Unfed aquaculture and integrated multi-trophic aquaculture – Theories and practices in China by JIANG Zengjie

China is the world's largest aquaculture producer, with total aquaculture output accounts for nearly 70 percent of world aquaculture production. Compared with other countries, the aquaculture in China is characterized by species-rich diversity, multi-trophic levels, and higher unfed rate. Unfed aquaculture is mainly contributed by mariculture. During the past several years, mariculture in China develops very fast and the total production rose from 0.55 million tonnes in 1980 to 21.35 million tonnes in 2020. Macroalgae and molluscs are the main species whose production accounted for about 83 percent of total mariculture production. However, the rapid development of mariculture has aroused increasing concern about the limited space, over carrying capacity operation, low productivity, and climate change stress, and so on. In recent years, the idea of IMTA has been considered a promising approach for recycling food and energy to increase profitability while mitigating environmental drawbacks. Several kinds of coastal IMTA systems have been developed at industrial scales in China, while experimental projects are now scaling up towards commercialization in Canada, Norway, and some other countries. The implementation of IMTA is attractive conceptually, but there are a number of considerations to be paid more attention, particularly at commercial scales. In January 2019, 10 governmental departments including the Ministry of Agriculture and Rural Affairs of China have jointly issued a guideline on the green development of aquaculture industry. As an important component of the mariculture, unfed species mariculture faces the new opportunities and need to explore more efficient ways.

APPENDIX VII: ABSTRACTS OF THE REGIONAL REVIEWS AND GLOBAL SYNTHESIS OF AQUACULTURE

The following section presents the abstracts of the FAO regional reviews of aquaculture, which are produced every five years. The full publications are available on FAO's dedicated website.⁶

Abstract of World Aquaculture 2020 – A brief overview

This document provides a synthesis of six regional aquaculture reviews: Asia-Pacific, Europe, Latin America, and the Caribbean, the Near East and North Africa, North America, and sub-Saharan Africa. Global aquaculture production, including aquatic plants, in 2018 was 114.5 million tonnes, with an estimated value of USD 263 billion. The Asia-Pacific region continued to be the major producer. Globally, aquaculture provides over 50 percent of fish for human consumption. In 2018, aquaculturists were reported to farm about 622 species or species items including 387 finfishes, 111 molluscs, 64 crustaceans, seven frogs and reptiles, ten miscellaneous aquatic invertebrates and 43 aquatic plants. From 2000–2018, aquaculture production in freshwater, brackish water and marine water increased at a compound annual growth rate of 5.7 percent, 7.7 percent, and 5.2 percent respectively while total aquaculture production grew at an annual growth rate of 5.6 percent.

Global food supply and per capita consumption of fish and fish products continued to increase faster than human population growth. However, in parts of Africa the apparent fish consumption has decreased. In 2018, 20.53 million people were employed in aquaculture and a higher proportion of women worked in the aquaculture industry than in the fishing industry. Aquaculture is striving to innovate in order to increase production and sustainability. Progress in biosecurity and fish health management, feed formulation and utilization, and genetic resource management are showing good, but uneven progress. Globally aquaculture has used over the last decades about 18 million tonnes of forage fish in the formulation of fish and animal feeds. Although domestication and genetic improvement have played a large role in the increased production in some species, the most widely cultured farmed type is the wild type.

In 2018, 37 percent of total fisheries and aquaculture production were traded internationally, with a total export value of USD 165 billion. The aquaculture sector faces challenges including competition for land and water resources, as well as external factors such as climate change, conflict, economic uncertainties and most recently the COVID-19 pandemic. The pandemic and other stresses such as droughts and tsunamis, revealed that the aquaculture industry has not engaged sufficiently in disaster preparedness. International and national mechanisms are being put in place to increase the sustainability, good governance, and social license of the sector to address these challenges. The diversity of the sector, the opportunities for good jobs and commitments by governments to good governance will help the sector meet these challenges. Aquaculture is, and will be, instrumental in helping countries implement the 2030 Agenda and to meet nearly all of the UN SDGs and other international instruments, particularly through contributions to food security and nutrition.

⁶ www.fao.org/fishery/regional-aquaculture-reviews/reviews-2020/en/

Abstract of the regional review on status and trends in aquaculture development in Asia and the Pacific – 2020

This regional review presents the development status and aquaculture trends in the Asia-Pacific region from 2008 to 2018. It analyses the factors that drive aquaculture growth, examines the issues and challenges and provides perspectives of the way forward for future development of the sector. The document is one of a series of reviews on aquaculture development in different regions and globally prepared for the Global Aquaculture Conference +20. Aquaculture in the Asia-Pacific region continued to grow from 2008 to 2018 at an average annual growth rate of 5.2 percent. Total aquaculture production in the region reached a historical high of 105 million tonnes in 2018, which accounted for 92 percent of global aquaculture production. Eastern and South-eastern Asia produced 90 percent of the region's total, while negligible production was observed from Oceania and Central Asia, accounting for 0.3 percent of the region's total. Aquaculture contributed significantly to achieving SDGs in the region. It provided over 60 percent of the 2017 average annual per capita food fish consumption in the region of 24.1 kg, supplying 25.2 percent of the average animal protein intake. The total value of aquaculture production in the region reached USD 223 billion and the sector directly employed 19.6 million people across the region in primary production and about the same number of people in related supporting and service businesses in 2018.

Aquaculture in the region has been making good progress to address its negative impact on environment and adapt to climate change for sustainability and resilience. It also contributes to conservation of aquatic biodiversity with hatchery seed production of endangered species for production and wild stock enhancement. Growth of aquaculture in the region has been driven by increasing demand for aquatic food in both domestic and international markets. The region has been the major producer and consumer of aquaculture products. It is also the major supplier, exporter and an increasingly important importer of aquaculture products in international trade. There has also been steady increase in the intraregional trade. Aquaculture development in the region has largely benefited from and been sustained by conducive government policies, well-established services such as aquafeed and quality seed production and supply, production intensification, improved animal health management, and strengthened overall sectoral governance. However, aquaculture growth in terms of the annual production growth rate has been slowing down especially in recent years and development is not geographically balanced across the region, indicated by production dominance by Eastern and South-eastern Asia, though great potential exists in other subregions.

Some major issues challenging the growth of aquaculture in the region include the vulnerability of small holders in access to resources and services, adaptation to climate change and other natural disasters, changing socioeconomic environment such as migration of young generation and market volatility caused by trade conflicts. Aquaculture in the region is expected to continue to grow to meet increasing demand for aquatic foods for growing populations. The growth will mainly be sustained through intensification with enhanced productivity and environmental performance. There is a need to further mainstream aquaculture into the national food production and nutrition security systems with adequate policy and resource priorities. Good governance needs to be promoted. Research needs to be strengthened with increased investment. Collaboration among multiple stakeholders and across the region needs to be strengthened to facilitate knowledge sharing, information dissemination and technology transfer.

Abstract of the regional review on status and trends in aquaculture development in Europe – 2020

This review reports on aquaculture development trends and challenges during 2000–2018 in the European Region covering 51 countries including European Union member states. Aquaculture production in the European Region is composed of marine molluscs and diadromous, marine and freshwater fish. It reached 3.4 million tonnes in 2018, while having a value of USD 16.6 billion. Atlantic salmon and rainbow trout combine to give nearly two million tonnes, with molluscs providing 0.7 million tonnes; marine fish species supplied 0.4 million tonnes and freshwater fish 0.3 million tonnes. In Europe, the strongest aquaculture growth has been seen in non-European Union states (for example Norway, Turkey, Russian Federation) while several European Union states have diminished production (for example France, Netherlands, Italy). The growth in value (5.8 percent) is higher than production (0.9 percent), which is now dominated by salmonids (nearly 60 percent), primarily Atlantic salmon. Mediterranean marine fish farming is mainly for gilthead seabream and European seabass. European cyprinid production in freshwater has increased slightly, where the Russian Federation, Czechia and Poland are the biggest producers. Mussels are the principal shellfish reared, led by Spain, followed by oysters in France and clams in Italy.

While publicly quoted companies have led salmon development in Northern Europe, elsewhere aquaculture is done, with few exceptions, by SMEs and micro-enterprises. Mechanisms for financial support exist for aquaculture development throughout Europe but these have not been matched by anticipated results. When unpredictable and time-consuming licensing procedures are combined with extreme competition for space and strict environmental regulations, both growth and investments are discouraged. Technology development focus has been given to structures appropriate for marine offshore or ‘open ocean’ operation. The use of RAS for large operations has also developed, both for hatcheries and for farms. Treatment for diseases and parasites remains problematic. Use of the same vaccines, veterinary treatments and disinfectants is not standardised, restricting the best health and welfare practices. Access to appropriate and efficient ingredients for formulated feeds remains a key issue for European fish farming, directly influencing productivity and profitability.

The European Union is the world’s largest single market for seafood and the most important destination for European aquaculture production. With preferences declared for wild products vs. farmed, the habits of the European consumer have been studied, indicating evolving influences on purchase decisions. These include the use of additives, food miles, climate change, acceptance of manufacturing practices, cost and access as well as health benefits. Adapting aquaculture production to consumer preferences and sensitivities means being able to provide stable and sustainable production, giving safe and high-quality food at affordable prices, and will require sectoral communication to improve public perception. Aquaculture policy development at the European level has been positive in many cases but has rarely been translated into visible development actions in certain nations. Aquaculture development strategies have been made throughout Europe, to support production increase, and address stagnation and reduction in performance. However, competition for space, licensing and public acceptance are blocks to predictable growth. Nonetheless, leading European public aquaculture, feed and equipment companies are active at the global level. International cooperation actions have been achieved or are ongoing to support European interests in the global development of aquaculture.

Abstract of the regional review on status and trends in aquaculture development in the Near East and North Africa – 2020

The Near East and North Africa (NENA) region covers 18 countries and territories: Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Syrian Arab Republic, Tunisia, United Arab Emirates, Western Sahara and Yemen with a total land area of 9.8 million km². The region is mostly arid or semi-arid but has extensive coastlines and includes a wide range of different economies from high income, hydrocarbon-rich countries to low-income states, some of which have been severely impacted by conflict in recent years. NENA aquaculture production was worth USD 2.3 billion in 2018, two-thirds of which came from Egypt and around one-quarter from Saudi Arabia. Production has grown rapidly since the 1980s, more than doubling over ten years and increasing by 50 percent over the five years preceding 2018 to reach 1.7 million tonnes. Egyptian fish farms accounted for 92 percent of production and Saudi Arabia for 4.2 percent while other significant producers included Iraq (25 737 tonnes), Tunisia (21 826 tonnes), Algeria (5 100 tonnes), the United Arab Emirates (3 350 tonnes) and the Syrian Arab Republic (2 350 tonnes). Although current aquaculture production levels are low, all these countries have high ambitions with further developing the sector, often for improved food self-sufficiency.

A total of 43 species of finfish, shellfish and aquatic plants were farmed in the region. Tilapia (mainly *Oreochromis niloticus*) was produced in 14 of the 17 countries in NENA and represented 63 percent of total 2018 production, followed by mullets (14 percent) and carps (12 percent). Marine finfish (gilthead seabream, European seabass, and meagre) represented around six percent of total production and shrimp (mainly whiteleg shrimp produced by Saudi Arabia) accounted for around three percent. The capacity to grow tropical marine finfish such as grouper, amberjack and yellowtail is increasing in all the Gulf States, but the quantities remain limited, while Asian seabass was mainly produced in Saudi Arabia and the United Arab Emirates. Small amounts of bivalve shellfish are grown in Algeria, Morocco, and Tunisia and more recently in the United Arab Emirates while even smaller quantities of aquatic plants are grown in Morocco and Tunisia. There is good potential for further growth of aquaculture production in the region through sustainable intensification of inland, freshwater and brackishwater aquaculture as well as expansion of marine aquaculture systems backed by strong policy and financial support. Egyptian aquaculture production was built on commitments by the government to allocate space and resources for development of the sector in the 1980s. Similar commitments have been made recently in other NENA countries including Bahrain, Morocco, Oman, Saudi Arabia, and the United Arab Emirates including establishing dedicated aquaculture development zones and carrying out consultation processes with other resource users as recommended in the FAO Ecosystem Approach to Aquaculture. Fish farmers need to improve the efficiency of feed and water use while fish health can be improved by implementing the FAO Progressive Management Pathway approach.

Environmental legislation has been enacted by most countries, although management systems need to be strengthened. Until now, most aquaculture production in NENA region has been for domestic markets, often with little attention paid to maintaining effective cold chains in post-harvest handling and market systems. Several countries lack the capacity to participate effectively in global aquaculture trade as they have not implemented essential testing frameworks or lack effective marketing approach and organizations. There is very little processing or packaging, and the COVID-19 pandemic has demonstrated the importance of local and flexible marketing systems, including on-line retailing. However, Saudi Arabia exports high quality shrimp to global markets and several other countries are also investing in the infrastructure and processes for exports. Egyptian aquaculture demonstrates that the sector can improve food self-sufficiency and food security as well as providing employment and incomes in rural areas where there are few alternatives. Aquaculture in the region has been impacted by climate change, conflict and the COVID-19 pandemic suggesting that effective resilience planning is needed. Management of the sector varies across the region and needs to be reviewed to ensure that regulatory frameworks provide appropriate levels of support. Representative organisations need to be strengthened to play a greater role in co-management of the sector. FAO has helped to build management capacity in several countries in line with the FAO Strategic Objectives, the SDGs and the FAO Blue Growth Initiative. It will be important for aquaculture sectors to actively engage with high-level bodies and ministries managing SDG processes to ensure that aquaculture contributions to SDGs are taken into account. FAO can continue to play an important role in continued success of the sector through its unique position as a trusted partner for governments, NGOs, and the private sector in NENA region.

Abstract of the regional review on status and trends in aquaculture development in North America – 2020

This document summarizes the status and trends of aquaculture development in North America, focusing on Canada and the United States of America, with some discussion on Bermuda, Greenland, and St. Pierre and Miquelon. Relevant aspects of the social and economic background of each country are followed by a description of current and evolving aquaculture practices and the needs of the industry in terms of resources, services, and technologies. Impacts of aquaculture practices on the environment are discussed, followed by a consideration of the response by the industry to market demands and opportunities, and its contribution to social and economic development at regional, national, and international levels. External pressures on the sector are described, including climate change and economic events, along with associated changes in governance. The review concludes with an analysis of the contributions of North American aquaculture to the SDGs, the FAO Strategic Objectives, and the FAO Blue Growth Initiative. Throughout the review, outstanding issues and success stories are identified, and a way forward is suggested for each main topic. Results of this review culminated in eight key findings:

- North America contributes a small and relatively steady level of aquaculture production (600 000 tonnes to 650 000 tonnes annually), but despite the steady production volume, the value of production has continued to rise over the past 25 years.
- Growing global demand for diverse seafood products is probably stimulating local production increases and trade agreements are currently being re-structured and expanded beyond North American parties.
- The increasing value of products over time has been attributed to value-addition initiatives, including branding, eco-certification, processing, and packaging so sector growth should continue to embrace such initiatives and to address consumer needs, through further diversification of product lines.
- Growing interest in species diversification has been attributed to challenges associated with environmental sustainability, such as reducing farm impacts, as climate change adaptation strategies, and business risk mitigators in regions affected by fluctuating or uncertain seafood product demand as well as price competition from imported products.
- Technology innovations and their application have contributed to increases in on-farm productivity and decreased production costs.
- Social license, and the negative public perceptions of the aquaculture industry, continue to have an impact on growth, although industry actions to improve its image are becoming increasingly effective.
- With extensive and optimal growing conditions, the region is beginning to embrace the opportunities associated with seaweed aquaculture.
- The regulatory burden for the aquaculture sector has remained high, with sometimes poorly harmonized regulations having an impact on the cost of doing business. Current initiatives in Canada and the United States of America are addressing these constraints to growth.

Abstract of the regional review on status and trends in aquaculture development in Latin America and the Caribbean – 2020

This document reviews the development of the aquaculture industry in the LAC region over the past decade. In 2018 aquaculture production in the region amounted to an estimated 3.1 million tonnes of aquatic products (excluding seaweeds) worth USD 17.2 billion at first sale. This food sector is vastly concentrated in a few countries with the combined output from Brazil, Chile, Colombia, Ecuador, and Mexico representing over 85 percent of the total regional production. Atlantic salmon, rainbow trout, tilapia, whiteleg shrimp and the Chilean mussel collectively contributed 80.4 percent and 85.9 percent of the regional production by volume and value, respectively. Marine aquaculture has been the dominant production environment in the region for the past two decades, accounting for 70.1 percent of the farmed output in 2018. Production models vary widely, with a concentration of large-scale companies in Chile, while primarily small- and/or medium-size operations in Brazil, Peru and several other countries.

Introduced species remain top on the list among those farmed such as tilapia and the different salmonids both of which have contributed to local livelihoods and employment. Tilapia farming has contributed significantly to food security in many countries of the region while the largest proportion of farmed salmonids have been destined to the export markets. Production prospects remain promising; however, the industry requires in general better governance, the adoption at all levels of appropriate technologies and best practices, and renewed efforts to guarantee environmental sustainability and social acceptance as well as competitiveness and foresight to deal with climate and market changes. The SIDS face additional challenges including limited expertise, high production costs, poor seed supplies, as well as extreme and destructive weather events. The report discusses issues that require wider regional attention for the aquaculture sector to grow. Key recommendations focus on governance-related improvements highlighting the need for solid sectoral development plans, support policies, and effective rules and regulations. The promotion of a stronger cooperation among the countries in the region as well as further afield on technical matters, species diversification and equal support to small and large-scale farming operation are identified as key elements to foster investment and help the region gain a solid position among world aquatic food producers.

Abstract of the regional review on status and trends in aquaculture development in sub-Saharan Africa – 2020

This review provides an overview of the status, trends, challenges, and projections for aquaculture in sub-Saharan Africa (SSA) and evaluates the major trends during previous five years. While the sector still faces various internal and external challenges, the inherent natural potential of the region and rapidly increasing demand for fish has resulted in increased prioritization of aquaculture in almost all SSA countries and the African Union and subsidiary bodies have given special attention to the sector development. In order to realize its full potential, the SSA region needs to address a combination of overarching factors limiting aquaculture development so far, such as ineffective development approaches, weak governance frameworks, underdeveloped value chains and low availability as well as the high cost of key production inputs.

Strengthened value chains for tilapia and catfish, promotion of new species, improved biosecurity, continued development of certification and associated harmonized best practices, improved information systems and innovations to address climate-change related impacts are some of the matters to be addressed. Financial institutions and private sector (national and international) have equally started investing, even though in the global picture such interventions may seem negligible, which makes the continent to call for more and higher levels technical and financial assistance from international partners. Upscale the status of production and productivity via healthy investments would help the sector to generate a variety of benefits including food security, livelihoods, employment, domestic and intra-regional markets, foreign currency income and other socio-economic benefits.

APPENDIX VIII: ABSTRACTS OF THE THEMATIC REVIEWS

Abstract of thematic review 1 on aquaculture systems

Since 2000, the aquaculture industry has become well integrated in the global food system. Aquaculture production has tripled, reaching a production of 85 million tonnes of aquatic animals and 35 million tonnes of aquatic plants in 2019. Aquaculture systems are highly diverse, producing globally equal live weight amounts of fed species and extractive species. In Asia and Africa, inland aquaculture provides the bulk of aquaculture production, while in the Americas, Europe and Oceania, marine aquaculture dominates. The realized growth is mainly due to intensification, use of more and better feeds, improved production management and increased attention to biosecurity.

Challenges to the industry include reducing the impact from fed aquaculture on pollution and global warming. Both fed and extractive aquaculture need to pay more attention to scaling, site selection and the health of the wider production environment. In terms of land use, aquaculture is more efficient than terrestrial animal production, but water use remains a challenge, and more attention should be given to water recycling in land-based systems, reducing water consumption and facilitating nutrient recovery and re-use.

Future development should focus on making the aquaculture industry climate neutral and reduce environmental impacts, both inland and at sea. More attention must be given to making aquaculture an important part of the food system on all continents, like is the case in Asia today. Increasing the global production volume should not be a major goal by itself. Integration of aquaculture into local nutrition-sensitive, circular, and sustainable food systems should become the major driver for future aquaculture system development.

Abstract of thematic review 2 on innovations on aquaculture

This review examines the status, issues, and challenges in aquaculture innovation, and explores likely areas of future innovation. It seeks to identify the engines and incentives that are behind the major areas of aquaculture innovation. The broad categories and sectors where innovation is occurring are described, as are the risks, benefits, and broader impacts – some of which are potentially less desirable. The review also explores policies that individual country governments and regional organizations can adopt to encourage innovations with preferable socio-economic outcomes.

High-profile aquaculture innovations include large-scale, intensive, land-based RAS systems; highly automated offshore net pen systems; increasing use of robotics and remote command-and-control; and novel financing tools for larger companies and small start-ups. However, more broadly impactful innovations are often less obvious: improved selective breeding; refinements in feed formulations; expanded use of vaccines; and better extension, outreach, and training for farmers.

Tensions can arise around aquaculture innovations that offer differing costs and benefits to different sectors. For example, offshore operations and intensive onshore RAS systems, in particular, benefit from increasing automation and economies of scale.

Greater scale and automation result in expanded production and more efficient yields. This can then move the industry closer to meeting global production goals, increase the availability of healthful aquaculture products to consumers, and lower the production costs and, therefore, possibly, market price. This can then provide broad societal benefits through improved nutrition. However, larger-scale, capital-intensive systems also displace small- or medium-scale producers, and increasing automation reduces the need for less-skilled labour.

By contrast, benefits from applying genetic technologies and bioinformatics tools are more broadly available, with fewer negative impacts. Some genetic technologies have been resisted, or more slowly adopted but could offer significant benefits to industry, genetic diversity, and ecosystem health. For example, targeted gene editing (targeting a gene known as dead end) can be used to produce 100 percent guaranteed sterile stocks. Such techniques could be applied to multiple species and can limit the negative impacts of sexual maturation on production and product quality, enable protection of intellectual property and prevent the interbreeding of farmed types with wild populations. However, regulation of gene editing, and gene edited products varies between jurisdictions and some will apply overly restrictive regulation of gene-editing which could also put their producers at a disadvantage. Governments need to be conscious of such dynamics when establishing aquaculture policies.

The review describes a range of government or agency policies that might encourage or constrain aquaculture innovation, such as:

- assertively focusing greater support for aquaculture expansion, to reduce the overall impact of food production systems on the global climate crisis, freshwater use, and land use, with concomitantly less support for more-impactful terrestrial animal proteins.
- expanding the use in aquaculture feeds of agricultural proteins and oils, including both crops and animal by-products, as well as optimizing the use of seafood processing by-products.
- encouraging innovative financial models, particularly for new start-up companies, and offering pre-permitting of areas for aquaculture use.
- balancing the dominance of larger-scale operations by supporting greater co-operative efforts for smaller-scale operators, such as application of the ‘nucleus estate’ model.
- replicating the broad benefits of collaborative selective breeding programmes, such as the GIFT program, in other aquaculture species.
- establishing collaborative programmes to preserve genetic resources in wild populations, such as for the slower-growing but more salt-tolerant tilapia species in Mozambique (*Oreochromis mossambicus*).
- fostering private sector, pre-competitive collaborations (such as the Global Salmon Initiative) to better address aquaculture’s challenges.

Governments should be careful not to inhibit the application of new technologies to protect those producers more dependent on the status quo. Policymakers should remember that seafood is one of the most-traded global commodities. Therefore, direct government involvement in market manipulation or direct investment is unlikely to establish an innovative, beneficial, or profitable industry.

Abstract of thematic review 3 on aquaculture and the SDGs

The SDGs need to capture the multiple contributions that the diverse aquaculture sector can offer. This partly reflects the infancy around the development of policies for aquaculture compared with its terrestrial counterpart, agriculture. This review highlights the need for better integration of aquaculture in the global food system – at multiple and different spatial-temporal scales. This by unpacking and increasing our understanding about aquaculture's present and future potential contribution to the SDGs. Aquaculture is presented as a unique sector that transcends all aquatic ecosystems (freshwater, brackish/estuarine and marine) and also being tightly interconnected with terrestrial systems. The review consists of a literature survey based on the SDGs indicators and how they link to aquaculture. A selection of case studies is presented to illustrate: 1) the diversity of the aquaculture sector and what role this diversity can play for contributions to the SDGs, 2) mapping methodologies and identification of delivery of the SDGs.

Trade-offs between farming systems' contribution to delivery on the SDGs, and the uniqueness of aquaculture's contributions compared to other food production systems, are discussed. This discussion includes understanding about species/systems diversity, the role of emerging aquaculture species/systems, interconnectedness between supporting systems. This review also explains how some of the lesser-known types of sustainable aquaculture and their wider benefits can assist countries when making trade-offs between aquaculture and other aquatic resource users competing for access to the same aquatic environment or resources. The review ends by identifying knowledge gaps and pathways for transformation that will allow further strengthening of aquaculture's role for contributing to the SDGs, including how a cohesive and comprehensive aquaculture strategy framed to meet the SDGs may help countries to prioritize for improving wellbeing.

Abstract of thematic review 4 on feed and feeding

Substantial progress has been made over the past twenty years in improving feeds and feeding for most aquaculture species. There have been notable improvements in feed efficiency (through a better understanding of requirements and improved feed management) and ingredient sustainability (through increased capability to use a wider range of ingredients). While advances have been made in understanding the requirements of many of the main aquaculture species, there is still much to be done on defining requirements, especially for many of the species being farmed in the developing world. Gains in the efficiency of feeds is slowing for developed species, but such gains are still appreciable for less developed species. There is a growing need to prescribe the required levels of essential nutrients and various additives more precisely in the diet based on age, genotype, environment, and immune status to deliver a "precision nutrition" approach to farming aquaculture species.

Plant resources remain the dominant ingredient used in compound feeds across the world. Whereas marine resources remain an important inclusion in many feeds, they are increasingly seen as a low-volume high-value resource with strategic applications. As a source of omega-3, marine resources still dominate supply, though microalgal and genetically modified crop options are emerging. There is still further need to diversify our ingredient options to provide greater resilience, as the sustainability of different feed ingredient sources, including possible climate change impacts, is becoming a growing issue.

There is an increased demand for biocircularity in our feed ingredient supply chains. Fundamentally what is needed to sustain future feed ingredient needs are sustainable sources of cost-effective protein, some essential amino acid additives, some omega-3 resources, plus various minerals, and vitamin additives. The increasing use of new and varied resources will ensure that food safety remains an important issue throughout the world. Feed manufacturing has evolved from a simplistic exercise to a highly complex science with state-of-the-art engineering. However, the application of such advanced feed manufacturing is not consistent across all sectors and further support is needed, as there is still widespread use of pelleting, mash, and trash-fish feeding in the developing world. Similarly, feed management has also dichotomised between the developed and developing world, with a high reliance on manual skilled labour in the developing world, whereas more advanced aquaculture systems are becoming increasingly reliant on automated computer-controlled feeding systems.

Abstract of thematic review 5 on aquatic genetic resources and seed supply

Effective genetic management of the numerous aquatic species that are cultured globally is an important factor that must be addressed for global aquaculture to make a significant contribution towards meeting the SDGs of the United Nations. The aim of this paper is to identify the current status and challenges relating to management of farmed AqGR and to make recommendations for future improvement of this management in four specific areas identified as needing increased attention.

The first section addresses sustainable use and conservation and covers farmed types and populations of their conspecific wild relatives.

This section summarises the conservation status of key species and highlights some of the issues constraining the sustainable use of domesticated genetic resources used in aquaculture. This section highlights the importance of having information and monitoring systems to assess this status of genetic resources in the wild and throughout the seed supply chain. It notes the importance of identifying threatened populations and setting up conservation programmes for these and of putting in place systems that can more effectively monitor of the status of domesticated resources and identify where interventions are necessary to ensure their effective genetic management. The second section is about risk management applied to manage genetic harm posed by distribution and production of introduced species, the use of which is already widespread in global aquaculture, and of developed farmed types which are becoming increasingly prevalent. It describes a step-by-step consideration of risk analysis for aquatic farmed types. The third section addresses the potential and technological development of breeding programmes as a tool to increase productivity and sustainability of global aquaculture production highlighting the urgency to accelerate the uptake of genetic improvement, especially of well managed selection programmes. The final section regards regulations addressing access to AqGR and the fair and equitable sharing of benefit arising from their utilisation. This section highlights those national and globally applicable instruments and regulations are available but are not always well suited to AqGR and are generally little used.

In summary, there is great potential for utilising AqGR more effectively to enhance global food production, and the wild conspecific relatives of the farmed types make up a reservoir of genetic variation that can underpin the effective utilisation of these resources into the future. However, this utilization must be done responsibly both with regard to management of conspecific wild populations and domesticated resources under national jurisdictions. It is necessary to improve awareness of the importance of effective management and development of genetic resources and develop strategies and national and international regulatory instruments to support and transformation in the way in which vitally important resources are managed.

Abstract of thematic review 6 on biosecurity: reducing the burden of disease

Fish is an important, nutritious, and chosen food commodity with a high consumer demand, requiring a continuously increasing volumes of supplies. According to FAO fisheries and aquaculture statistics, aquaculture accounted for 56.2 percent of combined global fisheries and aquaculture production in 2019 (120.1 million tonnes produced with a value of USD 274.6 billion). Aquaculture production accounted for 47.8 percent of fish for human consumption over the same year. With marine fish catches relatively static since the late 1980s, aquaculture has been responsible for the continuing impressive growth in the supply of fish for human consumption. If fish production and trade take place as “business as usual” (supply based on continued recent growth trends), there will be a significant demand-supply gap by 2030. Recent trends confirm that global aquaculture will continue to expand, diversify, and intensify over the coming decades, to bridge the demand-supply gap. What is important is that we bring our past experiences in tackling the hurdles and bottlenecks of sector growth, to ensure that this predicted expansion and intensification will result in sustainable aquaculture development and production.

One of the toughest hurdles that aquaculture sector experienced in the past is reducing the socio-economic burden of disease and managing health of cultured species. Disease is a major constraint to global aquaculture production. Conservative estimates suggest that 10 percent of all cultured aquatic animals are lost on global scale, due to infectious diseases alone, amounting to over USD 10 billion in lost revenue annually. During the past two decades, we witnessed increasing incidents of emergence and re-emergence of pathogens and diseases. It has also become apparent that when a disease emerged or re-emerged, it spread across the region and beyond, regardless of water or land barriers between.

This concludes that movement of pathogens and spread of diseases are much related to movement of fish, especially live animals destined for aquaculture or ornamental fish industry. There are also other routes of pathogen transfer such as wild reservoirs, ballast water, biofouling, microplastics, and water currents. Considering the unaffordable socio-economic burdens resulted in disease outbreaks and the complex nature of their spread, modern aquaculture disease control and health management strategies call for application of a holistic approach, encompassing total biosecurity. In this regard, FAO recently stated that “a paradigm shift is needed in dealing with aquaculture biosecurity risks”.

By the time, the pathogen has been identified and its host range determined, it may have already become widespread globally (including to wild populations), through the movement of live animals of uncertain health status, most often for aquaculture development.

Biosecurity in aquaculture consists of practices that minimize the risk of pathogen transfer, establishment and spread. These include practices for reducing the stress to fish, thus making them less susceptible to pathogens/disease. Over the past four decades, many disease outbreaks and mass mortality events in aquatic populations occurred, causing serious production losses and consequently food availability and job loss when farms are closed and markets affected, which have increased the awareness of the importance of biosecurity. Detailed analysis and assessment of the specific segments of the aquaculture value chain when pathogens may be introduced or disease may develop, help us to develop precautionary measures.

According to FAO’s novel approach – Progressive Management Pathway-Aquaculture Biosecurity – is defined as “cost-effective management of risks posed by pathogenic agents to aquaculture through a strategic approach at enterprise, national and international levels with shared public-private responsibilities”. Main components of a holistic and progressive biosecurity management approach should include, among others: a) animal management – obtaining healthy stocks and optimizing their health and immunity through good husbandry, b) pathogen management – preventing, reducing, or eliminating pathogens, c) people management – educating and managing relevant stakeholders, d) appropriate research and more importantly, and e) the conducive policy.

Abstract of thematic review 7 on dynamics of aquaculture governance

Aquaculture is a growing industry with an annual growth rate that is far superior to the population growth rate. Most production occurs in lower- and middle-income countries, and therefore, they are able to improve the efficiency and modernize the production systems to increase exports to earn foreign exchange earnings for economic and social development. The institutional arrangements should be part of the mechanisms that ensures sustainable aquaculture growth, through the participation of all stakeholders. Sustainability is possible with good and dynamic governance through which the industry embraces the basic principles of governance, equity, accountability, efficiency, and predictability. The paper shows that over the past decade several countries made changes in governance and implemented regulations through their action plans to improve aquaculture productivity, and stakeholders profited from the changes made along the value chain. For the producers to benefit from the value-added products, they complied with the regulations imposed by the importing countries, international regulatory bodies, or their own consumers. Standards increased, and the implementation of certification resulted in changes in the industrial structure. These standards, which inflict a cost on producers, stimulated an improvement in productivity and product quality. However, during the last decade production growth declined from 5.8 percent from 2001 to 2010 to 4.5 percent from 2011 to 2018, and realization of the potential of meeting the sustainable development targets has become more elusive. There is need for a paradigm shift that encourages small-scale producers to engage in sustainable intensive aquaculture. The challenge is, therefore, to move towards production intensification and expansion, and the harmonization of national and international regulations to ensure the supply of safe and adequate fish to consumers, while maintaining a sustainable production system, and at the same time conserving the environment and maintaining social and economic stability.

With good governance and the political will, the social, economic, and environmental objectives for attaining the SDGs during the period 2020 to 2030 are possible if governments integrate sustainable aquaculture developments within an expanded aquatic and terrestrial food security policy framework using systems thinking and open innovation approaches.

Abstract of thematic review 8 on social and human dimensions of aquaculture

Comparatively with other sector-specific issues, human and social dimensions in aquaculture are lagging behind. Sectoral, policy and programmatic factors and patterns have created inequities and weak outcomes, which are jeopardizing the contribution the sector could make to human wellbeing.

Human rights in aquaculture are at the core of this paper, which argues that aquaculture development needs to be about human development. The paper reviews “issues”, including the application human rights in aquaculture, and related right to decent work, the notions of justice and equity (including the idea of blue justice and its relevance in aquaculture), ethics and social licence to operate (with the challenges that business ethics and public acceptance pose to the sector). It also reviews how these issues affect “people”: women (along with slow progress in gender equality in the sector), youth and their engagement in aquaculture (noting that ‘youth’ does not equate ‘jobs’ and requires the lifting of many more societal hurdles for their full participation in the sector), Indigenous People and local ecological knowledge – a precious asset for future aquaculture as well as the survival and enhancement of the cultural value of aquaculture, and people with disabilities (and other minorities) who have yet to become fully visible and accounted for in aquaculture development.

Redressing human and social issues in aquaculture, and placing people at the centre of aquaculture development, require a fundamental change from business as usual. To humanize aquaculture development, a new human relationship with aquaculture is proposed, founded on the recognition of substantive equality and agency, the embracing of intersectionality and the value of cross-disciplinary knowledge systems, and implemented through new, inclusive, business models, social provisioning approaches and procedural justice and governance mechanisms enabling to overcome inequalities, where public, private and non-state actors are involved, and inclusive of small-scale farmers, women, youth, people with disabilities and indigenous communities as key groups.

Abstract of thematic review 9 on value chains and markets of aquaculture products

The sector of fisheries and aquaculture makes a significant contribution to food and nutrition security, employment, trade, culture, and economic development in the world. Global fish production was estimated at 178 million tonnes in 2019, supplying around 20.3 kg/capita per year and 17 percent of global animal proteins and many essential micronutrients. Likewise, around 60 million people are employed in the sector. Upstream and downstream activities in capture fisheries, fish farming, processing, transport and logistical services, insurance, aquatic animal health diagnosis and prevention, consulting and other financial services provide significant employment and economic benefits and foreign exchange earnings from export to many countries and coastal communities.

Fish production from capture fisheries has stagnated in the range of 86 to 93 million tonnes since the late 1980s, except for 2018 when it reached a high record level of 96.4 million tonnes. At the same time, the global demand for fisheries and aquaculture products has continued to rise. Consumption has more than doubled since 1973. The perceived health benefits of fish and the technological developments enabling its farming, processing and availability in the form of a wide range of fish products, including convenience products suited to modern and affluent lifestyles in many modern cities are key drivers of the growth in fish demand and consumption. Most of the increase in fish availability is the result of a robust increase in aquaculture production, estimated at an average 6 percent yearly growth during the period 2001–2018.

As a result, aquaculture production and aquatic product utilization have experienced significant developments locally, regionally, and globally during the last four decades.

Aquaculture products have become one of the most globalized food commodities, attracting interest of investors, agribusiness and retail companies, international development and financial institutions and non-governmental organizations who scrutinize the industry developments, through the lenses of the global value chain approach. This approach, originally known as the global commodity approach, explores how production, distribution and consumption of a given food commodity and its actors, economics and services are globally interconnected.

Over 80 percent of aquaculture production takes place in developing countries, mainly in Asia. At the same time, the major fish markets are in Europe, North America, and Japan. These markets accounted for 60 to 70 percent of world fish import in value. To participate actively in international trade, the institutional and operational capacity of the producing countries is challenged to guarantee food safety, animal health and compliance with international social and environmental requirements, regulations, and standards. Concerns have been raised following recurrent outbreaks of food and feed crises, increasing fears about food safety, spread of aquatic animal diseases, uncontrolled usage of antibiotics, development of antimicrobial resistance and the environmental and social impacts of aquaculture.

For over two decades, there have been concerns that, in different parts of the world, growth in aquaculture production has exceeded the capacity of planning, controls, and oversight. These concerns have progressively shaped the trade regimes for international market access and market entry and driven new schemes for aquaculture value chain development and governance on the international markets.

**APPENDIX IX: MEMBERS OF THE INTERNATIONAL ORGANIZING COMMITTEE,
INTERNATIONAL PROGRAMME COMMITTEE, AND THE LOCAL ORGANIZING COMMITTEE**

List of International Organizing Committee members

Name	Affiliation
Hossein Ali Abdolhay	Iranian Fisheries Science Research Institute (Iran [Islamic Republic of])
Danielle Blacklock	National Oceanographic and Atmospheric Administration (United States of America)
Giovanni Fiore Amaral	National Commission of Aquaculture and Fisheries (Mexico)
Alice Joan Ferrer	University of the Philippines, Visayas (Philippines)
Matthias Halwart	Food and Agriculture Organization (United Nations)
HU Honglang	National Fishery Technology Extension Center (China)
JIA Jiansan	Network of Aquaculture Centres in Asia-Pacific (Thailand)
JIE Huang	Network of Aquaculture Centres in Asia-Pacific (Thailand)
Robert Jimmy	Secretariat of the Pacific Community (Fiji)
LI Jiale	Shanghai Ocean University (China)
LIU Xinzhong	Ministry of Agriculture and Rural Affairs (China)
Beatrice Nyandat	Department for Fisheries, Aquaculture and the Blue Economy (Kenya)
Maria Célia Portella	Sao Paulo State University (Brazil)
Yngve Torgersen	Ministry of Trade, Industry and Fisheries (Norway)
Hav Viseth	Ministry of Agriculture, Forestry and Fisheries (Cambodia)

List of International Programme Committee members

Name	Affiliation
Jennifer Cobcroft	James Cook University, Townsville (Australia)
Elizabeth Cottier-Cook	Scottish Association for Marine Science (United Kingdom of Great Britain and Northern Ireland)
Lionel Dabbadie	Food and Agriculture Organization (United Nations)
Susan Farquharson	Atlantic Canada Fish Farmers Association (Canada)
Ruth Garcia Gomez	Secretariat of the Pacific Community (New Caledonia)
Antonio Garza	Fisheries and Aquaculture, State of Tamaulipas (Mexico)
Shivaun Leonard	US Agency for International Development (United States of America)
LIU Yingjie	Chinese Academy of Fishery Sciences (China)
Kay Lwin Tun	University of Yangon (Myanmar)
Graham Mair	Food and Agriculture Organization (United Nations)
Charles Ngugi	Karatina University (Kenya)
Imad Saoud	American University of Beirut (Lebanon)
Patrick Sorgeloos	Ghent University (Belgium)
Karen Veverica	Auburn University (United States of America)
YUAN Derun	Network of Aquaculture Centres in Asia-Pacific

List of Local Organizing Committee members

The Local Organizing Committee (LOC) was composed of representatives from Shanghai Ocean University, the China Society of Fisheries, and the Shanghai Municipality, as follows:

Name	Affiliation
LIU Xinzhong	Director-General of the Bureau of Fisheries within the Ministry of Agriculture and Rural Affairs
JIANG Kaiyong	Vice Director-General of the Bureau of Fisheries within the Ministry of Agriculture and Rural Affairs
ZHAO Liling	Counsellor II of the Bureau of Fisheries within the Ministry of Agriculture and Rural Affairs
LU Quan	Director of Division of International Cooperation of the Bureau of Fisheries within the Ministry of Agriculture and Rural Affairs
LIU Yingjie	Vice President of the Chinese Academy of Fishery Sciences
HU Honglang	Deputy Secretary General of China Society of Fisheries, the Deputy Director General of the National Fisheries Technology Extension Center
WANG Hongzhou	Chairman of Shanghai Ocean University
WAN Rong	President of Shanghai Ocean University

APPENDIX X: SELECTED POSTERS

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

All 177 posters which were accepted from 25 countries can be found on the GCA website, organized by theme.⁷ In addition, posters were printed and displayed in the conference venue in Shanghai, China, for the approximately 500 participants who attended in person.

Nine exceptional posters, one from each of the GCA themes, were selected by the GCA Secretariat. These nine authors presented their poster during a “lightening” session at the final plenary session and were then further invited to prepare a short article on their work for an edition of the FAO Aquaculture News publication. Their names and poster titles can be found in the table below.

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

⁷ www.aquaculture2020/posters

APPENDIX XI: SHANGHAI DECLARATION: AQUACULTURE FOR FOOD AND SUSTAINABLE DEVELOPMENT

The Shanghai Declaration: Aquaculture for food and sustainable development was adopted by the participants of the Global Conference on Aquaculture Millennium +20 on 24 September 2021. The full, final text is reproduced below, and a formatted publication in all official UN languages is available from www.fao.org.

Shanghai Declaration:

Aquaculture for food and sustainable development

I Preamble

1 Aquaculture has undeniably established its crucial role in global food security, with its production largely meeting the supply-demand gap for aquatic food in the past decades. Rising aquaculture production, together with many improvements along the aquaculture value chain, shifting consumer habits, and other socioeconomic factors have contributed to doubling the average apparent per capita consumption of aquatic foods since the 1960s, even though human population has also more than doubled in the same period. In 2018, aquaculture accounted for 48 percent of the total fish⁸ production and 52 percent of fish available for human consumption. Aquaculture makes significant contributions to livelihoods, employment, food security, and nutrition, and this contribution is expected to continue to grow through enhanced productivity and modernization, expansion and intensification, and increasing economic and geographic access and availability to nutritious farmed aquatic products.

2 At the same time, to feed an ever-growing human population, expected to reach almost 10 billion people by 2050, aquaculture development needs to continue its expansion while becoming more sustainable. Recognizing that the capacity of aquaculture for further growth, and also the need to avoid that such growth comes at the cost of deteriorating ecosystem health, animal welfare standards, biodiversity loss, or social inequalities, the aquaculture sector demands new, sustainable, and equitable development strategies. The private sector will remain the main actor in aquaculture production, and substantial public sector support and strong leadership will also be necessary with input and guidance from government and civil society playing essential roles in regulating aquaculture, and in supporting and promoting citizens' views, participation and benefits.

3 The Sustainable Development Goals (SDGs) are designed to be a "blueprint to achieve a better and more sustainable future for all". The SDGs focus on the elimination of hunger and reduction of poverty and inequality in all their forms, recognize the need for innovation and business development as well as social protection, commit to promoting and facilitating energy efficiency and clean energy, and seek to increase resilience to climate change, weather and natural disasters, market volatility and political instability. They further seek to reduce the pressure of human economic activity on the natural environment by stressing the need not just for habitat and ecosystem protection, but also increased resource use efficiency, and sustainable production and consumption, thereby spreading responsibility for delivering sustainability across all economic actors. Almost all the SDGs, and many associated targets, are relevant to aquaculture development, and aquaculture can make significant contributions to their achievement. Aquaculture's role for contributing the SDGs has not, however, been clearly identified or communicated, resulting in relatively weak inclusion in sustainability dialogues. The implementation of existing guidance and initiatives designed to promote sustainable aquaculture (including the Code of Conduct for Responsible Fisheries (CCRF) and associated Technical Guidelines, the 2000 Bangkok Declaration and the 2010 Phuket Consensus) broadly support delivery of the SDGs. The Shanghai Declaration aims to build on and expand the scope of the CCRF and previous international declarations, taking full account of global agreements of relevance to aquaculture, including the FAO Committee on Fisheries (COFI) Declaration on Sustainable Fisheries and Aquaculture adopted by FAO Members in February 2021. The work of the COFI Sub-Committee on Aquaculture, including the development of Guidelines for Sustainable Aquaculture, is crucial in this respect. The Shanghai Declaration aims to provide guidance on maximizing aquaculture's contribution to Agenda 2030 and its SDGs, and

⁸ The term "fish" in this Declaration includes all aquatic food production groups, including molluscs, crustaceans and other aquatic animals, but excludes aquatic mammals, reptiles, seaweeds and other aquatic plants.

specifically address three key questions: i) how does aquaculture contribute to the SDGs? ii) where does aquaculture need to be in 10 years? and iii) how do we get there?

4 The Shanghai Declaration was first outlined and developed by an invited group of experts, informed by regional and thematic aquaculture reviews commissioned by FAO in 2020 in advance of the Global Conference on Aquaculture Millennium +20 (GCA +20). Members of its International Organizing Committee and International Programme Committee further elaborated the Shanghai Declaration, with the Food and Agriculture Organization of the United Nations and the Network of Aquaculture Centres in Asia-Pacific acting as Secretariat while providing additional inputs. The advanced draft was posted online for comments by participants ahead of the GCA +20, which were considered in the final drafting.

II Vision, commitments and strategic priorities

We, the participants of the Global Conference on Aquaculture Millennium +20

1 *Recalling* the goal of the 2030 Agenda for Sustainable Development to end poverty and hunger everywhere, and noting that the world is not on track to achieve Zero Hunger, with up to 811 million people facing hunger in 2020, nearly one in three people in the world not having access to adequate food in 2020, and one in four children under five remaining chronically malnourished, underscoring the immense challenge of achieving the Zero Hunger target by 2030;

2 *Considering* that implementing Agenda 2030 and the associated SDGs, the Paris Agreement and the Addis Ababa Action Agenda, requires new modalities for developing coherent and effective policies, programmes and investments, and that these new modalities require strengthening development partnerships, including North-South and South-South Cooperation, among governments, producers, wider industry, scientists and the public to facilitate the incorporation of aquaculture into the design of sustainable and healthy agri-food systems that reduce poverty, increase the human health benefits of consuming aquatic products and minimize negative externalities that may result from some aquaculture practices;

3 *Recognizing* aquaculture's role in supporting countries to achieve sustainable development, particularly in the fight against poverty, hunger, and malnutrition, and its contribution to the global agri-food system,⁹ bearing in mind the continuous positive growth of the sector, which in 2019 contributed 85.3 million tonnes of fish as well as 34.7 million tonnes of aquatic plants, and *calling attention to* the wide diversity of the species produced by aquaculture through numerous production systems in diverse environments;

4 *Recognizing* that aquaculture is diverse, and that extensive, semi-intensive and intensive culture systems are all being practiced, ranging from small-scale backyard family fishponds to highly industrialized technologically-sophisticated market-driven commercial operations, and that aquaculture provides livelihoods and employment opportunities, generates economic incomes, and contributes to food security directly and indirectly;

5 *Noting* that fisheries and aquaculture products are among the most traded food commodities, with 37 percent of the fish production entering international trade, and *recognizing* that this trade generates an economic spillover effect creating jobs and providing producers and workers with a reliable income to buy sufficient, safe, and nutritious food, including fish, to meet their dietary needs;

6 *Recognizing* that aquaculture has been the fastest growing food production industry over the last five decades, has allowed the doubling of the average apparent per capita fish consumption since 1960, and is making increasing contributions to the provision of food for a growing population and to livelihoods all along the value chains, including pre- and post-production and supporting services;

7 *Emphasizing* that instruments such as the Agenda 2030 and its associated SDGs, the Common Vision for Sustainable Food and Agriculture, FAO Code of Conduct for Responsible Fisheries, the Bangkok Declaration and Strategy and the Phuket Consensus are mutually supportive and can work in harmony with the present Declaration to produce economically, socially and environmentally sustainable aquaculture value chains, and *further emphasizing* that implementing these instruments requires looking at sustainable and equitable development within and across all agricultural sectors in an integrated and holistic manner, taking into account synergies and trade-offs across sectors and across sustainability dimensions, while mainstreaming nutrition

⁹ Food systems encompass the entire range of actors and their interlinked value-adding activities involved in the production, aggregation, processing, distribution, consumption and disposal of food products that originate from agriculture, forestry or fisheries, and parts of the broader economic, societal and natural environments in which they are embedded.

and advancing sustainable agri-food systems;

8 *Noting* the request of the Committee on Fisheries (COFI) to the FAO to consider guidance for concrete actions for the sector – according to national contexts, capacities and priorities – on the economic, social, and environmental dimensions of sustainable development and on climate change adaptation and mitigation, and *welcoming* the endorsement by FAO Members of the 2021 COFI Declaration on Sustainable Fisheries and Aquaculture;

9 *Welcoming* the development of the voluntary Guidelines for Sustainable Aquaculture as a tool towards further development of national policies for the aquaculture sector's sustainability;

10 *Noting* the potential and opportunities of emerging concepts such as One Health,¹⁰ Nutrition-Sensitive Agriculture/Aquaculture¹¹ and Blue Transformation¹² to influence the development of sustainable aquaculture and its future trajectory;

11 *Recognizing* that developing aquaculture sustainably and equitably requires a holistic approach that values both human and animal health and welfare and *further recognizing* that aquaculture activities should be conducted in a manner that assures the health and welfare of farmed aquatic animals, by optimizing health through minimizing stress, reducing aquatic animal disease risks and maintaining a healthy culture environment at all phases of the production cycle.

12 *Noting with concern* the severe challenges posed to the natural world and humanity's well-being from the global climate crisis, *acknowledging* the recommendation of the UN High Level Panel for a Sustainable Ocean Economy to increase sustainable aquatic food production to help alleviate global climate impacts, and *recognizing* that many forms of aquaculture production (including the farming of algae, bivalves and filter feeding fish) can make significant contributions in this regard;

13 *Recognizing further* that gender equality and women's empowerment are critical to all SDGs, and that the aquaculture sector offers opportunities for women;

14 *Appreciating* the important role and contribution of small scale aquaculture in poverty eradication and in providing livelihoods, ensuring food security and nutritional needs as well as supporting the cultural heritage of local communities, especially in less developed countries where off-farm job opportunity is scarce;

15 *Noting with concern* that the COVID-19 pandemic has aggravated poverty, hunger and malnutrition, including an unprecedented impact on the aquaculture sector;

16 *Recognizing* that aquaculture can use energy more efficiently than some land-based animal production, and can be a very effective sustainable way of producing protein, essential fatty acids and important micronutrients;

17 *Recognizing* that aquaculture, when not developed in a sustainable way, can have a negative impact on the environment, and therefore the importance of applying an Ecosystem Approach to Aquaculture, as well as the need to continue reducing antimicrobial use in the sector and to ensure sustainable sourcing of feed ingredients, and *acknowledging* that some forms of aquaculture, such as pond fish farming, bivalve aquaculture or algae farming can provide a range of ecosystem services;

18 *Recognizing* the urgent need to intensify efforts to make full use of opportunities while addressing outstanding conceptual and practical challenges for sustainable aquaculture to fulfil its full potential;

19 *Noting* the need for aquaculture to be considered in global food sustainability dialogues, and as a national, regional and global priority, and the importance of developing strategic plans that encompass various subsets of the industry and wider community;

20 *Acknowledging* that urgent targeted action is needed to ensure aquatic food production and products continue to provide inclusive, effective and sustainable pathways to reduce poverty, secure livelihoods and underpin food security and nutrition, as vital to achieving the goals set in Agenda 2030.

We, the participants of the Global Conference on Aquaculture Millennium +20

21 *Support* a common and transformative **vision** for an aquaculture sector that leads the way towards more productive, efficient, resilient, climate-smart and socially and environmentally responsible agri-food systems, fulfils its potential to meet the increasing demand for safe, healthy, accessible and affordable aquatic food and aquatic products, with reduced impacts on the global environment, contributes to sustainable development and helps to eradicate poverty, malnutrition and hunger, and matures in an economically, socially

¹⁰ www.fao.org/one-health/en/

¹¹ www.fao.org/nutrition/policies-programmes/en/

¹² www.fao.org/3/ne576en/ne576en.pdf

and environmentally sustainable way.

22 *Recommend* the following overarching **commitments** to help achieve the vision, which are to be applied across each of the ten strategic priorities identified below:

1. ***Promote responsible aquaculture development*** – Responsible aquaculture explicitly considers the three dimensions of sustainability in a balanced and holistic way, paying special attention to the social dimension and vulnerable groups, with coordinated and coherent actions for its development throughout the entire value chain. Responsible aquaculture, built on due consideration of environmental, social and economic aspects, is transparent and bolsters credibility of the sector.
2. ***Promote good aquaculture governance*** – Good aquaculture governance consists of integrated, coordinated, multisectoral and ecosystem-based management, as well as nature-based and innovative solutions throughout the value chain. Good governance requires strong and effective leadership and accountability, and involves broad stakeholder engagement from across various disciplines and sectors for coherent, inclusive and effective governance mechanisms, including public policies and legal frameworks, risk management approaches, and planning and adequate monitoring mechanisms. Good governance requires strengthened capacities and cooperation of public and private sector institutions and other relevant stakeholders at all levels.
3. ***Strengthen partnerships to generate and share knowledge, information, and technology*** – Strengthened partnerships includes the reinvigoration of global development cooperation and networking among existing and planned centres of excellence, including through providing developing countries with financial, technological and capacity-building assistance through strengthened North-South and South-South cooperation. Inclusive dialogue platforms, creating and improving information systems and data collection, and facilitating flows of information enable better understanding of aquaculture’s contribution to sustainable development, including through the monitoring and evaluation of the sector. Modernizing traditional aquaculture with innovative approaches, digital technologies, capacity development programmes, and education and extension activities will unlock employment opportunities.
4. ***Invest in aquaculture innovation, research and development*** – Private and public investment in aquaculture should be better facilitated, aligned, prioritized and enhanced, and targeted towards measurable improvements in aquaculture performance throughout the value chain and with a long-term perspective. This requires an enabling environment, competent authorities, strengthened partnerships and multistakeholder innovation platforms. Investment should be well focused, comprehensive and at sufficient scale, and targeted at new technologies, research, development and innovation to unlock the full potential of sustainable aquaculture, to not just increase production but to address other issues such as poverty reduction, nutrition, employment, gender equality, inclusion, preserving ecosystems and biodiversity, adaptation to and mitigation of the impacts of climate change and other global impacts. Development assistance should pay particular attention to policy advice, human and institutional capacity development and monitoring and evaluation of progress.
5. ***Create open and transparent communication about sustainable aquaculture*** – Communication strategies, targeted to various audiences, are needed to disseminate and promote this Declaration and improve the image of aquaculture by highlighting its benefits (including its key role in nutrition and food security, livelihoods and economic growth, as well as its capacity to reduce the impacts of global climate change.), conveying an accurate image of its potential risks, and engaging in a respectful dialogue between different stakeholders, and encouraged and facilitated through a multistakeholder platform approach. Communication should include mainstreaming Agenda 2030 and its component instruments, including the SDGs, in the promotion, planning and development of aquaculture at international, national and local levels in order to further promote awareness and action towards their achievement. Communication strategies should also aim to increase the transparency and credibility of the sector and its social license to operate and improve knowledge, perceptions, and acceptability of aquaculture and its products.

23 *Identify* the following **strategic priorities** required to accelerate sustainable aquaculture development and its contribution to the SDGs, as described in Section III:

- A ***Expand the contribution of aquaculture to sustainable agri-food systems for nourishing nations, reducing poverty and providing healthy, nutrient-rich and climate-friendly food to people;***
- B ***Integrate aquaculture with the natural environment, with agriculture, capture fisheries, forestry, tourism, renewable energy and other sectors, and within agri-food systems for increased***

resilience;

- C Continually improve the performance of aquaculture, and its capacity to minimize impact on and make better use of natural resources and enhance ecosystem services;*
- D Promote aquaculture development approaches that conserve and improve ecosystems and biodiversity, and reduce the carbon intensity of food production systems;*
- E Protect and develop aquaculture based livelihoods and promote decent work and socially responsible enterprises;*
- F Ensure women's empowerment by enhancing women's full access to equal opportunities through gender-transformative policies;*
- G Promote opportunities for young women and men;*
- H Promote Indigenous Peoples' participation in aquaculture;*
- I Prepare for and potentially mitigate impacts from global crises, such as climate change, biodiversity loss, pollution and pandemics;*
- J Strengthen data and information collection and analysis for monitoring the progress and contributions of aquaculture.*

24 *Recommend* to all stakeholders the following Call for Action that addresses the overarching commitments and the ten strategic priorities of the Shanghai Declaration, with a set of major supporting actions to achieve the vision for sustainable aquaculture.

III Call for Action

A) Expand the contribution of aquaculture to sustainable agri-food systems towards nourishing nations and providing healthy, nutrient-rich and climate-friendly food to people

Aquaculture has a role to play in the transformation of current agri-food systems from feeding people to nourishing people, emphasizing the importance of nutrition and health as key outcomes of agri-food systems. Aquatic food is recommended as a key component of a diverse, healthy diet. Fish and other aquatic foods are important sources of protein, essential fatty acids and micronutrients, especially for the poor and vulnerable. However, there are differences in the nutrition composition of aquatic foods based on species, farmed type and production systems, as well as in the way these foods are prepared and consumed. Sustainable Food Systems (SFS) must generate positive value along three dimensions simultaneously: economic, social (including women, youth, nutrition and health) and environmental (with a particular focus on global environmental and climate change impacts). Importantly, aquaculture production must be considered as an integral part of the global agri-food systems with intrinsic linkages to capture fisheries and terrestrial agriculture.

Stakeholders may support this strategic priority by:

1. Recognizing the role of aquatic food needs to play in building sustainable agri-food systems, and in addressing hunger, and the triple burden of malnutrition;
2. Recognizing that aquatic food is a key dietary component in many poor countries, especially in Africa and Small Island Developing States, and that aquaculture has a strong potential to sustain future demand for aquatic food, but that aquaculture production is also imbalanced, with Asia generating 88.4 percent of the total in 2019;
3. Acknowledging that recent disruptions and threats to food security as a result of emerging crises like COVID-19 have led to a growing global demand for locally produced food items;
4. Recognizing that the growth in aquaculture production has not only had positive but also some negative impacts on people and the environment, and thus the need to maximize positive impacts and minimize negative impacts in further aquaculture development;
5. Encouraging the expansion of sustainable aquaculture wherever it can be practiced to mitigate global climate change and reduce its impacts, while increasing its supply for domestic consumption;
6. Adopting holistic and inclusive approaches, such as ecosystem approach to aquaculture, that link human, plant and animal and environmental health for a more sustainable and equitable aquaculture sector that is an integral part of a sustainable global agri-food system;
7. Adopting a nutrition-sensitive approach which considers the nutrient content of farmed aquatic foods;
8. Promoting the benefits of fish and other aquatic foods in diets (especially for pregnant women and children) and the inclusion of aquatic food in agri-food systems policies, given its potential and role in combatting all forms of malnutrition;

9. Promoting safe aquatic foods in national food-based dietary guidelines, school feeding programmes, and other food and nutrition strategies;
10. Encouraging partnerships and south-south cooperation for the purpose of enhancing the contribution of aquaculture to sustainable agri-food systems;
11. Adopting a holistic agri-food systems perspective, where possible, on the development of aquaculture to transcend the narrow focus of production issues, value chains and sectoral policies and contribute to achieving sustainable development in its three dimensions, economic, social and environmental;
12. Transforming supply chains, production, processing, trade and consumption of aquaculture food products as part of agri-food systems to make them more sustainable, resilient, ethical and inclusive;
13. Engaging and empowering social actors in the design and implementation of policies, programmes and investments to promote the access to and adoption of innovative and new practices and appropriate technologies;
14. Developing a Global Alliance connecting key institutions and stakeholders for sustainable aquaculture development and stronger advocacy in aquaculture;
15. Increasing awareness among policy makers/legislators of how sustainable aquaculture can contribute to sustainable development;
16. Promoting long term strategic planning of sustainable aquaculture, also including adequate implementation, monitoring and evaluation mechanisms of strategies, plans and projects to adjust rules, regulations, and incentives.

B) Integrate aquaculture with the natural environment, with agriculture, capture fisheries, forestry, tourism, renewable energy and other sectors, and within agri-food systems for increased resilience

Aquaculture production methods and practices are exposed to a range of environmental, social, and economic disruptions, including direct disruptions to on-farm activities, as well as indirect disruptions to inputs. The ability to respond, adapt and recover to such disruptions is a necessary condition for production resilience. Aquaculture, if not managed properly, can have negative impacts. Lack of spatial planning and suboptimal zoning and site selection and/or area management can expose production to greater risk of environmental disruption or impact, and represents major constraints to the expansion of the aquaculture industry. In addition, poor aquaculture planning can result in low farm productivity, complicate access to and use of land and water resources, and create conflicts with other resource users. Such conflicts can disrupt production and result in additional socioeconomic and environmental costs. Aquaculture systems interact with other agri-food systems, for example through the feed inputs and competition within markets, creating risk for economic disruptions and requiring an agri-food systems approach to maintaining resilience and sustainability. Stakeholders may support this strategic priority by:

1. Integrating aquaculture with other food production systems (for example combined rice and fish farming, integrated multitrophic aquaculture, aquaponics or other agricultural/livestock farming practices, saline-alkaline aquaculture) to enhance the sustainability, productivity, efficiency and resilience of people, communities and ecosystems;
2. Working across disciplines and sectors for greater policy coherence;
3. Promoting spatial planning and management to draw conceptual and operational guidance from the Ecosystem Approach to Aquaculture, developing aquaculture within the context of ecosystem functions and services, and developing aquaculture within the context of other sectors;
4. Strengthening aquaculture so that it takes place amongst numerous other activities and users of land and water (including in both rural, urban and peri-urban areas), develop joint objectives and strengthen guidance documents in key cross-cutting areas; and promote more integrated actions in aquaculture and across agriculture, forestry, fisheries and other economic sectors, that balance the different dimensions of sustainability, as well as marine spatial planning, integrated coastal zone management and integrated watershed management;
5. Promoting aquaculture that is interconnected with the global agri-food system, including through the use of sustainable aquaculture feed ingredients, the use of sustainable aquaculture products (including by-products) as animal feed ingredients and other inputs for agriculture, and supporting a diversity of production systems to prevent supply chain bottlenecks;
6. Stimulating demand-led and relevant research and innovations by strengthening partnerships and establishing and maintaining centres of excellence on aquaculture across the industry (private sector),

- academia, state and non-state actors, and encourage public-private partnerships and investments;
7. Investing in research and development for utilizing cultured aquatic plants as feed ingredients for aquaculture and terrestrial livestock and direct human consumption, to reduce the pressure on fish stocks and agricultural land, and reduce enteric methane emission from livestock;
 8. Encouraging and promoting the development of regional and national multistakeholder platforms to instigate collaborative joint working among industry, research, academic and other stakeholders to develop strategic research and innovation agendas for local, regional and national aquaculture development;
 9. Taking into consideration the need to ensure sustainability in all its aspects, economic, social and environmental and looking for synergies including with other sectors where possible and addressing trade-offs where necessary;
 10. Embracing broad stakeholder involvement, for example private enterprises, public authorities, academia and research, producers and other aquaculture workers' associations and other social and non-governmental organizations through consultation and active participation, strengthening partnerships, and the application of mediation and conflict resolution mechanisms to build consensus around sustainable development objectives;
 11. Bolstering private sector at all scales through inter alia the use of private public partnerships as a way to create shared value, to facilitate market entry and rights for small producers, to create an environment where the interests of civil society, businesses and government priorities are better understood and shared, and to leverage resources and knowledge, promote properly inclusive business models;
 12. Identifying common issues/concerns among food producing sectors and stakeholders as starting points for dialogue and coordinated/coherent action on aquaculture development;
 13. Creating inclusive dialogue platforms that lead to shared understanding and negotiated solutions across sectors and across the dimensions of sustainability, and developing tools to transform these solutions into changes in practices.

C) Continually improve the performance of aquaculture, and its capacity to minimize impact on and make better use of natural resources and enhance ecosystem services

Remarkable gains have been made in improving the efficiency of aquaculture production. However, as aquaculture and other sectors continue to grow, natural resources (for example, land, water, and raw materials for feed production) may degrade or become scarcer and competition will increase. Therefore, environmentally friendly, resource use efficient, and sustainable aquaculture should be encouraged, with due consideration to ensuring access to food for people and minimizing impacts on the environment.

Stakeholders may support this strategic priority by:

1. Recognizing the largely untapped potential of appropriate genetic technologies (both traditional and modern) to improve aquaculture production (especially in breeding), while conducting risk assessment before upscaling and dissemination of these technologies, ensuring that they are appropriate and adapted to local conditions, and while maintaining a cautious approach to the use of genetically modified organisms in aquaculture;
2. Strengthening broodstock and seed production and distribution systems for the conservation and sustainable use of improved aquatic genetic resources, and enhancing the extension and application of select farmed types;
3. Promoting the responsible use of emerging technologies like artificial intelligence, the Internet of Things, robotics, remote sensing, Geographic Information Systems, block chain technology and other tools to make aquaculture systems more precise, intelligent, climate resilient and sustainable;
4. Promoting aquatic biosecurity protocols and management agreements, including prevention of disease and integrated disease and pest management, and encourage measures to improve fish health and welfare;
5. Promoting control, prevention and management of transboundary aquatic animal diseases of relevance for aquaculture;
6. Harmonizing aquatic animal and plant health management approaches and measures and effective cooperation at national, regional and inter-regional levels in order to maximize the effectiveness of limited resources;
7. Depending on the national legal context or ratification status, adhering to relevant international

instruments related to the responsible use of antimicrobials, chemicals and veterinary drugs, including the FAO Action Plan on Antimicrobial Resistance (AMR) and principles of One Health, as appropriate;

8. Engaging with the feed industry to encourage the development and utilization of diversified and improved feeds that are precisely designed to the needs of farmed types based on age, genotype, environment and immune status;
9. Promoting species and practices with lower environmental impact, such as the farming of unfed and low trophic level species and species with efficient feed use as well as developing sustainable aquaculture practices, technologies and systems (including recirculating aquaculture and application of modern technologies);
10. Promoting decentralized and reliable supply of healthy seed to farmers, particularly small scale farmers;
11. Improving zoning or density of culture units in order to reduce the risks of habitat degradation, pollution and hypoxia;
12. Taking action to decrease aquaculture environmental footprint throughout the value chain, from production to consumption, including all the side industries associated with aquaculture, such as processing, transportation, storage and feed manufacture;
13. Encouraging governments, the fishing industry, aquaculture farmers and the feed industry to apply the principles of sustainability in the responsible use of wild fish in aquaculture feeds, including promoting the replacement of juvenile and low-value fish as feed with compound feed, while at the same time specifically avoiding the undermining of food security of local populations or other negative social or environmental impacts;
14. Reducing dependency on wild caught fish as sources for aquafeeds, increase the use of fishery processing wastes as raw material for fishmeal and fish oil, and promote use of alternative and sustainable feed ingredients (such as algae, insect meals, single cell proteins, or fish by-products) which are safe for the cultured organism and the environment;
15. Developing and promoting new, easy to use technologies to recycle and monitor “waste” nutrients from aquaculture to ensure their re-use within the ecosystem through integrated approaches and circular economy where waste from one part of the farming system is used by another part;
16. Improving the distribution of aquaculture products and the reduction of post-harvest losses to increase the positive impact of aquaculture;
17. Creating an enabling environment to target and support aquaculture innovation approaches that facilitate carefully planned innovations, gender-sensitive innovations, and fledgling innovations;
18. Encouraging technology transfer, networking, and partnerships in extension and education;
19. Encouraging public policies and efforts to practice more sustainable aquaculture and maintain ecosystem services through public and private incentives or rewards.

D) Promote aquaculture development approaches that conserve and improve ecosystems and biodiversity, and reduce the carbon intensity of food production systems

Many forms of aquaculture can provide ecosystem services and contribute to conservation, although its value and roles are rarely well recognized. Aquaculture systems depend on a variety of ecosystem services and products and therefore require healthy aquatic and terrestrial ecosystems. Although only accounting for a very small proportion of the environmental impacts of agriculture, aquaculture must, like other components of the global agri-food system, aim to minimize land use, safeguard biodiversity, reduce consumptive water use and substantially reduce effluents, wastes and greenhouse gas emissions.

Stakeholders may support this strategic priority by:

1. Conserving, protecting, enhancing and restoring ecosystems, their services and their biodiversity, including plant and animal genetic resources, water and soil resources, and at the same time prevent water pollution and reduce greenhouse gas emissions;
2. Applying the concepts of physical, ecological and social carrying capacity in aquaculture planning, use of environmental impact assessments, and monitoring aquaculture operations for impacts to ecosystems and biodiversity (including non-native or genetically altered species, transboundary aquatic animal diseases, and the use of antimicrobials and other chemicals);
3. Recognizing the advantages and promoting the use of extractive (for example, algae, bivalves and filter feeding fish) and unfed aquaculture species (for example, carps), including their provision of

ecosystem services such as water quality improvement, and their lower impact on surrounding ecosystems;

4. Conserving and responsible restocking endangered species and enhance fisheries productivity through culture-based fisheries, and as appropriate, encouraging production of endangered species and native species with potential for aquaculture, including through the necessary research;
5. Promoting aquaculture systems, where appropriate, for their ability to provide habitat and refuge for both terrestrial and aquatic biodiversity;
6. Addressing the risks of antimicrobial resistance and the impact of veterinary medicines and other chemicals in the environment associated with aquaculture;
7. Developing methods and parameters to value ecosystem services provided by aquaculture.

E) Protect and develop aquaculture based livelihoods and promote decent work and socially responsible enterprises

The positive contributions to sustainable development of aquaculture are well recognized, and the economic, social, environmental and cultural benefits should be accessible to all including local communities, and not driven only by the pursuit of production goals and economic efficiency. However, if aquaculture is poorly regulated, managed or planned, it may exacerbate historical inequalities and bring about negative impacts. Discriminatory access to resources and services (for example, land, seed supply, water and marine space, credit and finance) undermines the development of livelihoods based on aquaculture. Women and small scalefarmers are most likely to be disadvantaged as aquaculture enterprises scale up and develop, having less access to ownership of assets such as farming sites, production, processing and marketing assets, credit, insurance, technology and capacity building. In addition, as is the case in all agricultural sectors (and beyond), there is scope for the improvement of decent work conditions in the aquaculture sector.

Stakeholders may support this strategic priority by:

1. Supporting the formation, engagement and involvement with aquaculture organizations, including those representing women's interests, throughout the aquaculture value chain, and at all scales of aquaculture;
2. Protecting and improving rural livelihoods via the design and access to social protection schemes that are supported and sustained by governments;
3. Depending on the national legal context or ratification status, adhering to relevant international instruments related to social protection and decent work, such as the International Labour Organisation guidelines, the UN Declaration on the Rights of Indigenous Peoples, the Convention on the Rights of the Child, Addis Ababa Action Agenda, UN Universal Declaration on Human Rights, Convention for the Elimination of all Forms of Discrimination Against Women, gender relevant provision of the 2030 Agenda including SDG5 (gender equality), SDG8 (decent work and economic growth), and SDG10 (reduce inequalities), and the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security;
4. Working with the private sector and certification bodies to promote and enshrine fair and equitable treatment of aquaculture workers;
5. Developing training opportunities for youth;
6. Optimizing existing value chains and enhancing traceability and market competitiveness, inter alia by using digital and organizational innovations;
7. Ensuring an equitable distribution of benefits to producers and workers, including overcoming international trade barriers and fostering suitable working conditions in the sector through the promotion of a constant dialogue within the industry and government and organizing vulnerable groups in associations, cooperatives, and unions;
8. Bridge the rural divide and empower youth and women to access information, technology and markets, while taking a gender-transformative approach to innovations;
9. Facilitating flows of information and traceability along the supply chain in vertically integrated production systems;
10. Establishing capacity building programs aimed at the professionalization and (self-) regulation of the industry throughout the value chain and at all levels, including government personnel that need to be able to take decisions based on the most recent best scientific information available;
11. Developing legal frameworks tailored to the specificities of the aquaculture sector and of its actors,

- including women and other disadvantaged groups according to national circumstances;
12. Developing aquaculture-based leisure business (such as recreational fisheries or tourism) to generate additional income opportunities for farmers and improve livelihoods;
 13. Accelerating the identification and protection of traditional aquaculture systems that can potentially be listed to the Globally Important Agriculture Heritage System so that valuable traditional aquaculture modes would be revitalized.

F) Ensure women's empowerment by enhancing women's full access to equal opportunities through gender-transformative policies

Systemic factors that disadvantage women in economic and social structures have also applied to the development of aquaculture. Women have not benefited equally because their business and employment opportunities are circumscribed by, among other aspects, lack of sex-disaggregated data for use in planning and monitoring, and aquaculture policies that do not distinguish different women's and men's needs in development. The causes of gender blindness are rooted, largely, in development policies and research; discriminatory legislation, traditions and attitudes; and women's lack of access to decision-making. Of critical importance is the extent to which rural people, in particular small scale family farmers, youth and women, have secure and equitable human and labour rights, access to knowledge, personal security, health, essential services, markets, and resources, including land and water, control over their livelihood through decent business and work opportunities, and access to diverse and nutritious food. More information is needed on women's current engagement in aquaculture, and what makes women lose (or retain) control over their activities depending on the scale, intensity and value of aquaculture enterprises. Overcoming gender-blindness, empowering women in aquaculture and making the development of aquaculture gender-transformative is the responsibility of everyone in the sector.

Stakeholders may support this strategic priority by:

1. Reviewing and promoting national legal amendments to remove and take action against gender and other forms of discrimination in laws and regulations framing directly and indirectly aquaculture development, and secure access of socially-marginalized groups to resources essential for aquaculture;
2. Mainstreaming gender targets in all aquaculture certification, accreditation, and labour policies and practices, as well as in toolkits and guidance on aquaculture development. Aquaculture practitioners need good technical instruments for gender-responsive planning, indicators of progress, training and communications;
3. Funding research that documents and analyses the causes of gender inequality to combat systemic gender inequalities and develop transformative solutions;
4. Increasing visibility and rewards for equal opportunities at all levels, including for leadership and decision making for women's participation and empowerment in the sector, promote aquaculture interventions that have the potential to transform gender relations;
5. Promoting equal opportunities and substantive equality in the aquaculture value chain through redressing disadvantage, addressing not only stigma and stereotyping in employment but also discrimination and abuse, and accommodating differences including through removing structural impediments to inclusion;
6. Increasing the understanding of the social dimensions of sustainable and equitable aquaculture, including the need to pay more attention to the situations and roles of women, and, where necessary, challenging the status quo.

G) Promote opportunities for young women and men

Aquaculture is not always a first choice of livelihood by youth, due to political, economic, technical, and social factors, limited access to space and water, financial services, markets, limited involvement in policy dialogues on issues that affect youth, and insufficient access to knowledge, information and education. Our knowledge on how these barriers play out on youth's motivation to join and partake in aquaculture is incomplete. Youth also face a near gerontocracy, and young women's access to educational opportunities and resources is even more proscribed than that of young men.

Stakeholders may support this strategic priority by:

1. Developing aquaculture training and education, and include it in existing curricula;
2. Building a youth-oriented approach to engage young women and men by creating attractive

- employment and income opportunities, tapping into their creativity and information and communication technology, virtual, and spatial skills, and supporting knowledge and skill building;
3. Funding research to understand the impact of economic, political and social shifts at global to local levels on youth involvement in aquaculture and develop solutions to motivate and engage young men and women to engage in aquaculture sector;
 4. Promoting policies that explicitly target impacts on young men and women's involvement, based on understanding the diversity among youth and their needs;
 5. Developing education programmes and curricula relevant to sustainable aquaculture;
 6. Increasing the understanding of the social dimensions of sustainable and equitable aquaculture, including the need to pay more attention to the situations and roles of youth, and, where necessary, challenging the status quo.

H) Promote Indigenous Peoples' participation in aquaculture

Sustainable aquaculture provides healthy, nutritious and culturally appropriate food and it could represent an opportunity for socio-economic development by Indigenous Peoples. Indigenous People might benefit, if they so desire, from equitable access to aquaculture resources and value chains and equal participation and representation in policy-making processes associated with aquaculture development.

Stakeholders may support this strategic priority by:

7. Depending on the national legal context or ratification status, adhering to relevant international instruments related to Indigenous Peoples, including the United Nations Declaration on the Rights of Indigenous Peoples;
8. Ensure equitable representation and effective participation of Indigenous Peoples in the planning, consultation and decision-making process;
9. Cooperate to identify ways in which aquaculture can contribute to the nutrition and development of Indigenous Peoples, through the gathering and strengthening of evidence and information, statistics, and development of actions that assist and demonstrate their contribution to their self-determination;
10. Endeavour to obtain Free, Prior and Informed Consent (FPIC) for development of aquaculture activities with Indigenous Peoples, and prevent the development of inappropriate aquaculture that may negatively impact them;
11. In collaboration with Indigenous Peoples and taking into account their knowledge and traditions, establish guidelines to facilitate the development of public policies aimed at the development of aquaculture production systems by Indigenous Peoples;
12. Promote the exchange of information and experiences among countries in support of Indigenous Peoples involved in aquaculture;
13. Based on Indigenous Peoples' food and knowledge systems, identify key issues to support aquaculture development in their Indigenous Peoples' Food Systems, combining Indigenous Peoples' traditional knowledge with innovation, and develop collaborative frameworks to advance their involvement in aquaculture, develop policy and strategies to improve nutrition and health, and develop through interculturality, culturally acceptable aquaculture systems based on the respect of FPIC and where there is a demand;
14. Increasing the understanding of the social dimensions of sustainable and equitable aquaculture, including the need to pay more attention to the situations and roles of Indigenous Peoples, and, where necessary, challenging the status quo.

I) Prepare for and potentially mitigate impacts from global crises, such as the climate change, biodiversity loss, pollution and pandemics

Global crises, such as climate change and the COVID-19 pandemic, have disrupted supply chains and markets, and caused human suffering and death around the world. Supply chains and markets are now being modified in response to the pandemic; world experts believe that the next ten years will be crucial in addressing the impacts of the climate crisis in order to avoid irreversible damage to the environment. Aquaculture, because of its diversity of farming systems, species and environments, can adapt to market forces, has more opportunities for lower 'carbon footprint' that can lessen or mitigate the impacts of the global climate crisis, and can help the overall food supply system be more resilient to other impacts such as natural disasters and human conflict. Stakeholders may support this strategic priority by:

1. Embracing and expanding climate-friendly or climate resilient aquaculture with appropriate planning and management to understand where and how aquaculture can address climate change and other external impacts to the agri-food system;
2. Taking action to prepare for and adjust to both the current effects of climate change and the predicted impacts in the future;
3. Enhancing and/or developing environmental monitoring systems to strengthen aquaculture resilience and improve early warning;
4. Implementing risk reduction strategies, including through contingency planning for droughts, floods or pest outbreaks, and the adoption of more diversified and resilient production systems associated with effective safety nets;
5. Developing aquatic farmed types adapted to changing environmental conditions caused by climate change, diversifying aquaculture production, improving farming practices, promoting integrated farming systems and enhancing the capacity of farmers to respond to climate risks;
6. Where options exist, using a variety of species and production technologies that have lower carbon and environmental footprint than terrestrial species;
7. Utilizing traditional and modern and sustainable genetic technologies responsibly to create farmed types that are resistant to, can adapt to, or can minimize the impacts of climate change, for example able to withstand acidification, salinization and temperature and precipitation changes, through inter alia better conversion efficiency and wider environmental tolerances;
8. Identifying the sector's vulnerabilities to the impacts of climate change (for example, acidification, temperature changes, extreme weather events) and other external impacts specific to each area and developing disaster preparedness, risk mitigation and climate change adaptation strategies;
9. Locating aquaculture facilities away from areas that have a high probability of damage from external factors, such as floods, droughts and tsunamis;
10. Supporting and promoting the development and expansion of climate-friendly and more resilient forms of aquaculture;
11. Recognizing that the changing global climate could provide new opportunities for aquaculture due to the diversity of farmed types and culture systems available to the farmer and proactively promote these opportunities;
12. Integrating climate-proofing innovations that increase adaptation and resilience of the sector, including innovations in institutions, emissions reductions and renewable energy systems such as co-locating aquaculture with wind turbines or photovoltaic power generation or using renewable energy heating and cooling systems and water pumps;
13. Understanding and applying risk analysis for aquaculture planning and management (pathogen, food safety and human health, genetic, environmental, climate, ecological [pests and invasive species], financial and social risks).

J) Strengthen data and information collection and analysis for monitoring the progress and contributions of aquaculture

The compilation of accurate, relevant and timely data facilitates monitoring, comparisons and analyses of status and trends that are essential for the responsible development of aquaculture and the sustainable utilization of the resources it requires. Accurate assessments of the status and progress of aquaculture support governments and relevant stakeholders in formulating better informed policies, strategies and plans and in the monitoring and reporting of aquaculture's contributions to economic development, food security and poverty alleviation.

Stakeholders may support this strategic priority by:

1. Improving aquaculture data collection and information systems paying attention not only to production but also to direct and indirect employment through the value chain, environmental performance indicators, and economic indicators;
2. Adopting methods of evaluating aquaculture and supply/value chains to include quality of production (nutritional and food safety) as well as quantity, making use of internationally accepted indicators of food and nutrition security and health outcomes and environmental impacts;
3. Encouraging monitoring and evaluation of sector progress, including targets and indicators aligned with the Follow-up and Review Framework of the 2030 Agenda, in support of monitoring and

- reporting on contributions of sustainable aquaculture to the SDGs;
4. Mandating the collection and dissemination of sex-disaggregated and other data relevant to gender equality in every jurisdiction and systematically use these data in aquaculture planning and development;
 5. Creating and maintaining open and transparent aquaculture information systems and improving aquaculture data collection and analysis, including sex-disaggregated data and statistics for reporting progress and contribution of the sector to the SDGs;
 6. Strengthening transparency and outreach of the biannual CCRF survey and progress reporting on sustainable aquaculture in FAO's Committee on Fisheries, and its Sub-Committees on Aquaculture and Fish Trade.

The Shanghai Declaration and its Call for Action were developed and adopted by the participants of the Global Conference on Aquaculture Millennium +20.

APPENDIX XII: LIST OF ORGANIZATIONS AND INSTITUTIONS THAT PROVIDED PLEDGES OF SUPPORT TO THE SHANGHAI DECLARATION ON AQUACULTURE FOR FOOD AND SUSTAINABLE DEVELOPMENT

- Aquaculture without Frontiers
- African Union-Interafrican Bureau for Animal Resources
- Aquatic Life Institute
- ASEAN Fisheries Education Network
- Asian Fisheries Society
- Bangladesh Shrimp and Fish Foundation
- Thai Union Feed Mill PCL
- Benchmark Holdings PLC
- Centro Internacional de Estudios Estratégicos para la Acuicultura
- Chinese Academy of Fishery Sciences
- European Aquaculture Society
- European Aquaculture and Technology Platform
- Federation of European Aquaculture Producers
- Food and Agriculture Organization of the United Nations
- Gender in Aquaculture in Fisheries Section, Asian Fisheries Society
- Global Salmon Initiative
- Global Seafood Alliance – The Center for Responsible Seafood
- Global Sustainable Seafood Initiative
- Global Seaweed STAR Initiative
- HAKI
- ICAR-National Bureau of Fish Genetic Resources
- International Fishmeal and Fish Oil Organisation
- International Salmon Farmers Association
- Ministry of Agriculture and Rural Affairs of the People's Republic of China
- Mississippi State University
- National Institute of Fisheries Science
- Network of Aquaculture Centres in Asia-Pacific – Centre on Integrated Rural Development for Asia and the Pacific
- Network of Aquaculture Centres in Central and Eastern Europe
- Organización del Sector Pesquero y Acuícola del Istmo Centroamericano
- Paul Ricard Oceanographic Institute
- Regional Commission for Fisheries
- Shanghai Ocean University
- Southeast Asian Fisheries Development Center
- Stirling University
- The Pacific Community
- Tongwei Co. Ltd.
- United Nations Global Compact
- Universiti Malaysia Terengganu
- World Aquaculture Society
- WorldFish
- Young Professionals for Agricultural Development
- Zhejiang University

The Global Conference on Aquaculture Millennium 2020 (GCA +20) was held as a hybrid event in Shanghai on 22 – 25 October 2021. The GCA +20 was the fourth in a series of development-oriented aquaculture conferences with the ambition of shaping global aquaculture. FAO was requested by the Thirty-third Session of the Committee on Fisheries (COFI) to collaborate with the Network of Aquaculture Centres in Asia-Pacific (NACA) with preparations of the GCA +20, as was done previously in 2000 and 2010. Under the theme “Aquaculture for food and sustainable development”, the GCA +20 aimed to bring stakeholders from government, business, research, academia, and civil society together to identify the policy and technology innovations, investment opportunities and fruitful areas of cooperation in aquaculture for food and sustainable development.

A key output from the GCA +20 was The Shanghai Declaration on Aquaculture for Food and Sustainable Development that highlights the principles and strategic pathways to maximize sustainable aquaculture in achieving the Sustainable Development Goals, with a special focus on “Leaving no one behind” and that was endorsed unanimously by the conference participants representing a broad range of key aquaculture stakeholders. Furthermore, a Global Synthesis of the aquaculture sector, six regional reviews and nine thematic reviews were produced for the conference.

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