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COMMITTEE ON FISHERIES

SUB-COMMITTEE ON AQUACULTURE

Ninth Session

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AQUATIC GENETIC RESOURCES FOR AQUACULTURE DEVELOPMENT

Executive Summary

This Working Document highlights the importance of the use, management and conservation of aquatic genetic resources for food and agriculture, provides an overview of previous recommendations and ongoing activities in support of aquatic genetic resources, and identifies potential areas for prioritization in light of limited human and financial resources.

The Sub-Committee is invited to:

- Take note of and consider further the information provided in this Working Document;
- Review and comment on the information and background documents pertaining to the SoW AqGR Report, and on the posting of the draft revised SoW AqGR Report for comments by members and observers of COFI:AQ, and experts of the COFI Advisory Working Group on Aquatic Genetic Resources and Technologies by 25 February, 2018;
- Request FAO to review and revise the draft revised SoW AqGR Report in view of comments received by the Sub-Committee, the COFI Advisory Working Group on Aquatic Genetic Resources and Technologies and the Ad Hoc Intergovernmental Technical Working Group on Aquatic Genetic Resources for Food and Agriculture;
- Request the COFI Advisory Working Group on Aquatic Genetic Resources and Technologies to continue to review the CCRF for articles and principles relevant to AqGR;
- Review and provide guidance on the main priorities for FAO's work on aquatic genetic resources for food and agriculture;
- Provide guidance on how to improve information or information systems that can inform policy and improve access and benefit sharing of AqGR;
- Support resource mobilization efforts to implement priority areas in regards to aquatic genetic resources for food and agriculture.

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INTRODUCTION

1. The sustainable use, management and conservation of aquatic genetic resources (AqGR) for food and agriculture is crucial to the continued growth and sustainability of aquaculture. There is also still an urgent need to preserve and better manage existing aquatic genetic diversity to enhance its contribution to food security, nutrition and livelihoods. Aquatic genetic resources for food and agriculture include thousands of species, which are found in the world's oceans, seas, lakes, reservoirs, rivers, rice paddies and other wetlands, and also in aquaculture facilities in marine, brackish and fresh waters.

2. The COFI Sub-Committee on Aquaculture (COFI:AQ) has addressed AqGR for food and agriculture at previous sessions and made a series of recommendations to FAO including that:

- technical support and capacity building be provided to Members in, inter alia, the areas of selective breeding and policy development noting that genetically improved varieties and domesticated stocks of aquatic species will further assist adaptations to climate change¹
- FAO assist development of guidelines on responsible use and exchange of aquatic genetic resources and on the application of genetic technologies, research and technology transfer;
- employ a regional approach, and that a framework or network for data and information should be created for the exchange amongst aquaculture/fishery genetic research institutions, development agencies and relevant international organizations;
- the COFI Advisory Working Group on Aquatic Genetic Resources and Technologies (COFI WG AqGRT) analyze means for developing countries to gain access to genetic technologies and improved breeds of aquaculture species;
- activities related to aquatic genetic resources and technology be supported from extra budgetary funding sources;²
- there should be an exchange of information between the Commission on Genetic Resources for Food and Agriculture (Commission) and the COFI WG AqGRT, in particular for the preparation of the State of the World Report on Aquatic Genetic Resources for Food and Agriculture (SoW AqGR);³
- AqGR be included in one of the seven priority areas of work for the COFI:AQ.⁴

3. FAO and its Members have heeded the above recommendations and have recognized the value of AqGR and related technologies in implementing the Code of Conduct for Responsible Fisheries (CCRF). FAO and Members are currently engaged in a number of activities that will help promote AqGR in achieving the above recommendations and FAO's strategic objectives. The following significant events have taken place in regards to AqGR since the last session of this Sub-Committee (COFI:AQ VIII):

- The COFI WG AqGRT has begun its work and will convene its second meeting at the margins of COFI:AQ IX;

¹ FAO Committee on Fisheries/Comité des pêches/Comité de Pesca. Report of the fifth session of the Sub-Committee on Aquaculture. Phuket, Thailand, 27 September – 1 October 2010.

² FAO Committee on Fisheries/Comité des pêches/Comité de Pesca. Report of the sixth session of the Sub-Committee on Aquaculture. Cape Town, South Africa, 26–30 March 2012. FAO Fisheries and Aquaculture Report No. 1006. Rome, FAO. 2012. 59 pp.

³ FAO Committee on Fisheries/Comité des pêches/Comité de Pesca. 2014. Report of the seventh session of the Sub-Committee on Aquaculture. St. Petersburg, Russian Federation, 7–11 October 2013. FAO Fisheries and Aquaculture Report No. 1064. Rome, FAO. 53 pp.

⁴ FAO Committee on Fisheries/Comité des pêches/Comité de Pesca. Report of the eighth session of the Sub-Committee on Aquaculture, Brasilia, Brazil, 5–9 October 2015. FAO Fisheries and Aquaculture Report No. 1131. Rome. Italy. www.fao.org/3/a-i5191t.pdf

- The Ad Hoc Intergovernmental Technical Working Group on Aquatic Genetic Resources for Food and Agriculture (ITWG)⁵ convened its first meeting⁶ in June 2016 to advise FAO on the structure and content of the first SoW AqGR;
- FAO convened an International Symposium in February 2016 on The Role of Agricultural Biotechnologies in Sustainable Food Systems and Nutrition and two of four planned Regional Meetings on Agricultural Biotechnologies will take place in Sub-Saharan Africa and Asia-Pacific in 2017;⁷
- FAO produced a first draft of the SoW AqGR;⁸
- FAO published draft Thematic Background Studies to support the SoW AqGR;⁹
- FAO convened an expert meeting on Incorporating genetic diversity and indicators into statistics and monitoring of farmed aquatic species and their wild relatives (FAO, Rome, April 2016);¹⁰
- FAO produced a first draft of the State of the World's Biodiversity for Food and Agriculture (SoW BD);¹¹
- The Government of Germany funded the project Enhancing the Contribution of Aquatic Genetic Resources to Food Security;
- The Islamic Republic of Iran received a Technical Cooperation Programme (TCP) project on the Genetic Improvement of Rainbow Trout in the Islamic Republic of Iran (TCP/IRA/3602);
- The Republic of the Union of Myanmar received a TCP Facility on the Genetic Management and Improvement of Tilapia (TCP/MYA/3503 BABY05);
- The Republic of Cuba received a TCP project for the Establishment and Implementation of a Genetic Improvement Program for Freshwater Fish (TCP/CUB/3501 D);
- The Republic of the Union of Myanmar received a TCP project on the Improvement of Tilapia Seed Production and Grow-out Culture Management in Myanmar (TCP/MYA/3606);
- The Democratic Republic of Timor-Leste received a TCP facility for a Feasibility study and pilot culture production of marine finfish cage culture (grouper, snapper) in Timor-Leste (TCP/TIM/3502 BABY 04);
- The People's Republic of Bangladesh, the Republic of Indonesia, the Republic of the Philippines, the Democratic Socialist Republic of Sri Lanka and the Socialist Republic of Viet Nam received a Regional TCP project to Promote scaling-up of innovative rice-fish farming and climate resilient Tilapia pond culture practices for blue growth in Asia (TCP/RAS/3603);
- The Republic of the Philippines received a TCP project on Building Capacities for a Climate Resilient Tilapia Farming in the Philippines (TCP/PHI/3502);
- The United Republic of Tanzania received a project to support the Development of Mariculture Sector in Zanzibar (GCP/URT/146/ROK);
- The Socialist Republic of Viet Nam received a TCP facility on the Assessment of causes and impacts of failed intensive shrimp farming on livelihoods of small farmers and piloting sustainable shrimp farming through organic farming supported with rehabilitation of destroyed mangroves in provinces of Soc Trang and Bac Lieu, Viet Nam (TCP/VIE/3502 BABY04);
- The Republic of Kenya received a TeleFood project to Support farmers Groups to Improve Shrimp and Milkfish production and market linkage (TFD-16/KEN/001-003);
- The Republic of Cameroon received a TCP project for the Support for the development of caged culture of Tilapia in Cameroon (TCP/CMR/3506).

4. The value of AqGR was highlighted in all of these fora, projects and publications. It is clear that AqGR can provide increased production, resilience, efficiency and profitability to the

⁵ www.fao.org/3/a-mr395e.pdf

⁶ www.fao.org/3/a-mr406e.pdf

⁷ www.fao.org/about/meetings/agribiotechs-symposium/en/

⁸ www.fao.org/3/a-mr785e.pdf, available in all UN languages

⁹ www.fao.org/fishery/AquaticGeneticResources/en

¹⁰ www.fao.org/fishery/static/aqgenres/TBSAqGRStatisticsAndMonitoring.pdf

¹¹ www.fao.org/fileadmin/templates/nr/documents/CGRFA/CGRFA-16/mr762e.pdf

conservation and responsible use of the world's aquatic biodiversity. However, as FAO and others have previously stated, the potential of AqGR has not been fully realized in fisheries and aquaculture.

GENERAL ACTIVITIES IN SUPPORT OF AQUATIC GENETIC RESOURCES FOR FOOD AND AGRICULTURE

5. Management and development of responsible aquaculture, and traceability of fish and fish products require identification, management and monitoring of aquatic genetic diversity both on farm and in the wild. Increasingly, policy makers, government resource managers, the aquaculture private sector and rural communities are asked to promote responsible genetic technologies, to develop better policies and to better identify the resources used and the suitable indicators of the status of those resources.

6. FAO has highlighted in various fora that many countries require assistance in these areas due to a combination of elements including, inter alia, limited national capacities and expertise, limited information on genetic resource use, and limited legislation and policy frameworks. There are in fact a wide variety of activities that can help countries realize the full potential of their AqGR and for which countries may need assistance (Table 1). Some of these activities are underway now and are presented in more detail below.

Table 1. Potential areas of FAO's work in support of the responsible use of AqGR in aquaculture

Activity	Description/Examples
1. Genetic improvement programmes	Selective breeding, hybridization, polyploidization
2. Breed or strain development	Genetically improved farmed tilapia (GIFT)
3. Genetic characterization	Gene sequences, genetic markers such as SNPs, micro-satellites
4. Risk/benefit analysis	Precautionary approach
5. In situ conservation	On farm conservation, conservation of wild relatives in nature
6. Ex situ conservation	Live gene banks, cryopreservation
7. Use of non-native species and strains	Precautionary approach
8. Exchange of species and germplasm	Material transfer agreements; Access and Benefit Sharing protocols
9. Genetic analysis of wild populations	Genetic stock identification of Atlantic cod, Pacific salmon and Atlantic salmon
10. Genetic analysis of farmed populations	Genetically categorize farmed populations for traceability
11. Establishment of a registry of farmed types, e.g. strains, hybrids, triploids.	FishBase ¹²
12. Establishment of an information system to document and monitor AqGR	FishTrace, Fishbol ¹³
13. National policy analysis	National Aquaculture Legislation Overview ¹⁴
14. AqGR incorporation in traceability and marketing	FishPopTrace ¹⁵
15. AqGR incorporation into climate change adaptation and mitigation	Voluntary Guidelines to Support the Integration

¹² www.fishbase.org

¹³ Species identification using genetic markers (<https://fishtrace.jrc.ec.europa.eu/>) and (www.fishbol.org/).

¹⁴ www.fao.org/fishery/nalo/search/en

¹⁵ Origin assignment, genetic information accessible but genetic data not yet available (<https://fishpoptrace.jrc.ec.europa.eu/>).

	of Genetic Diversity into National Climate Change Adaptation Planning ¹⁶
16. Establishment of a framework of minimum requirements for sustainable use, management and conservation of aquatic genetic resources	See relevant section below

Framework of minimum requirements for sustainable use, management and conservation of aquatic genetic resources

7. Recognizing the need to assist members in developing and managing their aquatic genetic resources, FAO in consultation with the COFI WG AqGRT agreed on the need to develop a comprehensive “Framework of minimum requirements for sustainable use, management and conservation of aquatic genetic resources of relevance for aquaculture.” This need is currently being addressed with the generous support of the Government of Germany.¹⁷

8. The Framework will include, inter alia, principles of sustainable genetic resources management, capacity building and training, protocols on transfer of genetic resources, necessary infrastructure, and development of supportive policy, capacity building, access to improved breeds and access to genetic technologies.

9. The Framework will be a set of minimum criteria regarding capacities, infrastructure, governance and information sources on aquatic genetic resources use, conservation and management. The Framework will be developed as a tool for countries to assess their current situation, their major needs, limitations and constraints, and the possible strategies to develop, use and conserve their aquatic genetic resources. The Framework will be tested in a selected country as a pilot programme and be refined accordingly. Furthermore, the Framework will become a policy brief on responsible development of AqGR, which will be produced in a second stage outside the activities of this proposal.

10. However, funding is only secured for the first steps of developing the Framework. Regional implementation and capacity building will be required for the activity to have global impact.

COFI Advisory Working Group on Aquatic Genetic Resources and Technologies

11. The COFI WG AqGRT held its first meeting prior to COFI:AQ VIII¹⁸ and will hold its second meeting before COFI:AQ IX. In addition to providing guidance on the Framework above, members of the COFI WG AqGRT have provided technical input to the processes associated with the preparation of the SoW AqGR. FAO gratefully acknowledges the valuable contributions of the COFI WG AqGRT experts.

12. At present, FAO has no regular programme officer with technical expertise in the rapidly growing field of aquatic genetics. In light of the expanding role of AqGR in food security and poverty alleviation, it is expected that there will be additional need for input from the expert group as well as regular programme expertise in the field of aquatic genetic resources and technologies.

The State of the World’s Aquatic Genetic Resources for Food and Agriculture

13. At its Eleventh Regular Session, the Commission agreed that improving the collection and sharing of information on aquatic genetic resources is of high priority and included the preparation of

¹⁶ www.fao.org/3/a-i4940e.pdf

¹⁷ Enhancing the Contribution of Aquatic Genetic Resources to Food Security – GCP/GLO/777/GER

¹⁸ www.fao.org/3/a-i5553e.pdf

the SoW AqGR into its Multi-Year Programme of Work (MYPOW).¹⁹ The main source of information for the SoW AqGR Report is country reports, officially submitted to FAO.

14. The Commission also invited the COFI WG AQGR to contribute to the preparation of the Report.²⁰

15. Despite the crucial role of farmed aquatic species and their wild relatives in contributing to global food security and sustainable livelihoods, information available on farmed AqGR and their wild relatives tends to be scattered and is generally incomplete. There are still major gaps in reporting aquaculture data at country level, and, as a result to FAO. Furthermore, characterization of aquatic genetic diversity at levels below that of the species is limited to a relatively small number of species and countries.

16. Lack of data and information and inadequate standardization result in poor understanding of the status and trends of AqGR. There is, however, growing recognition that improved information on the status, trends and drivers affecting AqGR will be increasingly important to support sustainable aquaculture and to improve food security and nutrition. There is also an increasing body of information on farmed aquatic, including aquatic plant, genetic resources and on genetically distinct fish stocks, cryptic species and wild relatives, but there is an increasing need for more information to underpin sound management. At the same time, many countries lack the capacity and/or the resources to collect information on AqGR diversity.

17. Countries have submitted country reports on their AqGR for food and agriculture. To date (April 2017), FAO has received over 80 country reports and more submissions are expected. These country reports provide a wealth of information on AqGR and have been incorporated into a database for analysis.

18. A first draft SoW AqGR Report has previously been produced based on the country reports received as of June 2016. This draft although recognized as being based on a limited number of country reports has provided useful information on the status and trends of AqGR for food and agriculture and related technologies and policies. For example:

- several country reports include more species and species types than have been previously reported to FAO (Table 2);
- traditional selective breeding is the most common type of genetic improvement strategy used by countries;
- numerous strains of aquatic species are being used in aquaculture, but there is no mechanism in FAO²¹ at present to document or monitor their use;
- although selective breeding is the most common form of genetic improvement, most aquaculture facilities farm the 'wild type', i.e. not domesticated or genetically improved;
- the wild relatives of farmed aquatic species are extremely important in aquaculture and capture fisheries;
- the populations of many wild relatives that are fished have declined in recent years;
- the main reason for the decline in wild relatives is habitat loss and degradation;
- the use of non-native species is extremely important in aquaculture;
- national policies exist regarding the use of AqGR, but often constrain access to AqGR.

¹⁹ CGRFA-11/07/Report, paragraphs 60-61.

²⁰ CGRFA-15/15/Report, paragraph 65.

²¹ FAO uses the Aquatic Sciences and Fisheries Information System (ASFIS) as the standard format for reporting aquatic taxa. ASFIS does not have the capacity to register strains, breeds, varieties or subspecies. It does have the capacity to record inter-specific hybrids.

Table 2. Selected countries with additional number of species reported in country reports

Country	Total number of species reported	Number included in ASFIS	Additional species
Guatemala	17	10	7
Indonesia	41	34	7
Japan	22	15	7
Kenya	33	14	19
Madagascar	26	15	11
Philippines	54	39	15
Sri Lanka	39	24	15
Thailand	117	70	47
Viet Nam	67	55	12

19. The Commission further approved the preparation of four Thematic Background Studies²² to complement the SoW AqGR:

- Incorporating genetic diversity and indicators into statistics and monitoring of farmed aquatic species and their wild relatives;
- Biotechnology and genomics in aquaculture;
- Genetic resources for farmed seaweeds and freshwater macrophytes; and
- Genetic resources for microorganisms of current and potential use in aquaculture.

20. These studies provide further information on AqGR and technologies that have previously not been reported to FAO and are made available as Session Background Documents 3,4,5,6,7.

21. Work is continuing on analyzing the country reports and on revising the current draft SoW AqGR Report. Documentation on the progress to date will be made available to the COFI WG AqGRT and to the COFI:AQ.²³ In light of the Commission's request, at its last session, that COFI and its subsidiary bodies, as appropriate, review the revised SoW AqGR Report and provide inputs, the Sub-Committee may wish to request that the draft revised SoW AqGR be posted online for written comments by members and observers of COFI:AQ and experts of the COFI WG AqGRT by February 25, 2018. Comments would then be consolidated by the Secretariat and submitted, together with the draft revised SoW AqGR, for review by the ITWG at its second session scheduled for April 2018 (see below). Following review by the ITWG, the revised SoW AqGR Report will be submitted to the 33rd Session of COFI for further input.

Improving information and statistics on AqGR

22. One of the main goals of the SoW AqGR is to improve the state of information on AqGR. The information contained in the country reports has been incorporated into a database and represents the beginning of an information system that can inform policy and improve access to and sharing of benefits from AqGR. At present, the country reports are restricted, but following the publication of the SoW AqGR the information will become public.

23. The Thematic Background Study on incorporating genetic diversity and indicators into national statistics²⁴ included advice from international experts²⁵ who highlighted how information on AqGR could be used in sustainable fisheries and aquaculture (Table 3). The experts further developed options for an information system on AqGR that ranged from a simple registry of strains and farmed types used in aquaculture along with their special characteristics, e.g. the Genetically Improved Farmed Tilapia (GIFT), mirror carp, and disease resistant white leg shrimp, to a more comprehensive information system that characterized, monitored and assessed the status of AqGR on a regular basis. The financial

²² www.fao.org/fishery/AquaticGeneticResources/en

²³ COFI:AQ/IX/2017/Inf.8

²⁴ www.fao.org/fishery/static/aqgenres/TBSAqGRStatisticsAndMonitoring.pdf

²⁵ www.fao.org/3/a-i6373e.pdf

and technical resources, as well as capacity building, required for the registry would be very small in comparison to the resources required for the more comprehensive information system that included regular monitoring and assessment.

Table 3. Possible uses of information about AqGR²⁶

Aquaculture	
	Identification of organisms for selective breeding programmes
	Monitor inbreeding and genetic diversity in farmed groups
	Broodstock management in aquaculture and culture based fisheries
	Management of conservation hatcheries
	Development of a registry of strains or other farmed types
	Identification of specific pathogen resistance strains or populations
	Identification of tolerance to certain environmental conditions (e.g. salinity, oxygen levels and temperature)
	Identification of useful genes or markers for breeding programmes
	Improve traceability of farmed species and products
Fisheries	
	Stock identification
	Cryptic species identification
	Fishery management through genetic stock identification
	Assess introgression with farmed or introduced species
	Improve traceability of fish and products
	Improve conservation of fish stocks
	Assess genetic viability and effective population size
	Alien species identification
	Inbreeding assessment
	Compatible species or stocks for population recovery programmes
Conservation	
	Assess genetic viability of populations and effective population size
	Alien species identification
	Inbreeding assessment
	Compatible species or stocks for population recovery programmes.
	Cryptic species identification

The Ad Hoc Intergovernmental Technical Working Group and Aquatic Genetic Resources for Food and Agriculture

24. The FAO Commission established the Ad Hoc Intergovernmental Technical Working Group on Aquatic Genetic Resources for Food and Agriculture (Working Group) to guide the preparation and review of the SoW AqGR Report.²⁷ FAO is following the advice of the Working Group as work continues on the SoW AqGR Report. The 16th Session of the Commission recommended that a second session of the Working Group be convened to provide additional advice on a revised SoW AqGR Report.²⁸

25. In addition to advice on a revised SoW AqGR Report and the Commission's desire to have the COFI WG AqGR contribute to the production of the SoW AqGR Report, the Sub-Committee may wish to request the COFI WG AqGR to continue the examination of the CCRF for articles and

²⁶ This list is not exhaustive and other uses may be possible from www.fao.org/fishery/static/aqgenres/TBSAqGRStatisticsAndMonitoring.pdf.

²⁷ CGRFA-15/15/Report, paragraph 63.

²⁸ www.fao.org/nr/cgrfa/cgrfa-meetings/cgrfa-comm/sixteenth-reg/en/

principles relevant to AqGR and convey their findings for further elaboration at the second session of the Working Group tentatively scheduled to be held in April 2018.

PRIORITIES FOR WORK ON AQUATIC GENETIC RESOURCES

26. The Sub-Committee recognized the role AqGR can play in FAO's programme of work. Clearly there are numerous and substantial activities that FAO can undertake to increase the role of AqGR in food security, poverty alleviation, conservation, and sustainable aquaculture. However, these activities will require human and financial resources. Therefore some prioritization of activities for FAO will be required taking into account the needs of Members and the comparative advantages of FAO. Table 1 provides a summary of main areas of work that FAO could undertake in regards to AqGR.

27. In order to address any of the areas of work in Table 1 however, additional funds will need to be made available and dedicated to AqGR. FAO gratefully acknowledges the contributions from the Government of Germany in this regard.

GUIDANCE SOUGHT

28. The Sub-Committee is invited to:

- Take note of and consider further the information provided in this Working Document;
- Review and comment on the information and background documents pertaining to the SoW AqGR Report, and on the posting of the draft revised SoW AqGR Report for comments by members and observers of COFI:AQ, and experts of the COFI Advisory Working Group on Aquatic Genetic Resources and Technologies by 25 February, 2018;
- Request FAO to review and revise the draft revised SoW AqGR Report in view of comments received by the Sub-Committee, the COFI Advisory Working Group on Aquatic Genetic Resources and Technologies and the Ad Hoc Intergovernmental Technical Working Group on Aquatic Genetic Resources for Food and Agriculture;
- Request the COFI Advisory Working Group on Aquatic Genetic Resources and Technologies to continue to review the CCRF for articles and principles relevant to AqGR;
- Review and provide guidance on the main priorities for FAO's work on aquatic genetic resources for food and agriculture;
- Provide guidance on how to improve information or information systems that can inform policy and improve access and benefit sharing of AqGR;
- Support resource mobilization efforts to implement priority areas in regards to aquatic genetic resources for food and agriculture.