Indian J. Plant Genet. Resour. 35(3): 285–288 (2022)
DOI 10.5958/0976-1926.2022.00083.3

FAO Resources for Strategic Planning

Graham Mair* and Daniela Lucente
Food and Agriculture Organization of the United Nations, Viale delle Terme Di Caracalla, Rome, Italy

Effective management of aquatic biodiversity used in aquaculture will play a critical role in the future development and sustainability of the sector. In this context, a global assessment, conducted by FAO, on the status of management of aquatic genetic resources for food and agriculture (AqGR) identified a number of significant challenges and needs. In response to this report, FAO and partners have been developing a number of key resources to facilitate countries to better manage their AqGR. This paper describes these resources, which include, *inter alia*: a framework of essential criteria; AquaGRIS – a global information system; and a *Global Plan of Action for the Conservation, Sustainable Use and Development of Aquatic Genetic Resources for Food and Agriculture*. These resources can be applied at a range of different levels by diverse aquaculture stakeholders such as policy makers, resource managers, producers and researchers, and can be integrated and used together in the development of strategic approaches for the management of aquatic biodiversity at national, regional and even global scales.

Introduction

It is well accepted that biodiversity underpins sustainable growth in food production and must be effectively managed for future food security. This is every bit as important for aquatic as it is for terrestrial biodiversity. FAO is committed to support countries to move towards more responsible management of biodiversity and to collaborate with partners (academia, research institutes, governmental and non-governmental organizations) to achieve this goal.

Aquatic genetic resources or food and agriculture (AqGR), are represented by DNA, genes, chromosomes, tissues, gametes, embryos and other early life history stages, individuals, strains, stocks and communities of organisms of actual or potential value for food and agriculture. *The State of the World's Aquatic Genetic Resources for food and agriculture* (FAO, 2019a), the first global report on the status of AqGR, illustrated some key points of differentiation for these resources compared to terrestrial genetic resources. One of the major points is that most aquaculture species have been domesticated for a much shorter period than terrestrial genetic resources and thus retain higher levels of genetic diversity than their terrestrial counterparts. With our present day understanding of the importance of genetic diversity and the plethora of tools available to us to characterize and manage such diversity, we have a window of opportunity to act to secure the future of AqGR, but real action is required in the near future to ensure we do not squander this opportunity. Paramount among the identified needs and challenges are:

1. **The lack of information on the status of AqGR**: Most countries know which species are cultured but generally there is little information available on genetic resources below the level of species (i.e. farmed types such as strains or varieties).[1] Lack of reliable information constrains policy makers and resource managers to develop effective management strategies for AqGR and often means that producers have confusing and unreliable information about the diversity and characteristics of the genetic resources available for culture.
2. **Some genetic resources are at risk but conservation needs are often undetermined**: Without information on both cultured species and their wild relatives[2] there is no information on the status of threat to these genetic resources. Creating a knowledge base on cultured and wild relative resources enables identification of resources that may need to be conserved locally, either *in situ* and/or *ex situ*.

**Author for Correspondence: Email-graham.mair@fao.org*

1. "Farmed types" refers to a farmed aquatic organism that could be a strain, variety, hybrid, triploid, monosex group, or other genetically altered form or wild type and is considered a generic descriptor of AqGR below the level of the species (Mair and Lucente, 2020).
2. Wild relative refers to an organism of the same species as a farmed organism (conspecific) found and established in the wild, i.e. not in aquaculture facilities.

Even species that are cultured extensively such as common carp and Pangasius catfish can be under threat in the wild.

3. **Unsustainable use of AqGR**: The majority of cultured species have no systematic genetic improvement programme in place. Among the majority of farmed types in aquaculture that are not the result of planned selective breeding, poor genetic management is commonplace. Deficiencies in genetic management include inadequate diversity of founder stocks, maintenance of low effective population size, breeding of close relatives, and uncontrolled hybridisation. Such practices can lead to loss of genetic variation, genetic drift, inbreeding and unplanned hybrid introgression which in turn have negative consequences for aquaculture such as loss of adaptive potential, declining performance due to inbreeding depression, reduced response to selection (when applied) and loss of specific characteristics of species. These effects are cumulative and, once in place, are difficult to reverse.
4. **The slow uptake of genetic improvement**: It is commonly understood that selective breeding should be at the core of most attempts to develop farmed types for aquaculture and the benefits and economic returns from selection programmes are well proven. However, the uptake of selective breeding is slow and it is considered likely that no more than 15 percent of global aquaculture production results from well-managed breeding programmes. Selective breeding can improve commercially important traits for aquatic species by 10-13 percent per generation and thus there is a very significant opportunity to generate cost-effective increases in aquaculture efficiency through accelerated application of appropriate genetic improvement. Therefore, it is important to identify those aquaculture species and sectors that would benefit most from the application of genetic improvement and to identify the most appropriate method of genetic improvement based on the analysis of their likely risks and benefits.

A Framework of Essential Criteria

Following stakeholder consultation and validation, FAO has developed a framework of minimum requirements in the management of AqGR (Framework) that can assist countries to establish conditions necessary to sustainably manage their AqGR (FAO, 2018). It represents a needs assessment document that calls for national dialogue to develop an implementation strategy, and a review or revision of national policy and practice, and furthermore to identify national gaps and needs for a sustainable management of the AqGR. The Framework provides guidance on a set of essential requirements that would need to be met to facilitate effective management of AqGR and these fall under five distinct components: information and databases; governance, policy and planning; infrastructure and equipment; capacity building and training; and enabling the private sector. In any specific country, stakeholders can map current policies, practices, infrastructure and resources onto the elements of the Framework and assess which requirements would need to be created or better developed in a particular area in order to enhance national capacity for effective management of AqGR.

AquaGRIS – A Global Information System for AqGR

The global assessment (FAO, 2019a) identified the lack of information on AqGR as a principal constraint to building effective management strategies. FAO is addressing this through the development of the Aquatic Genetic Resources Information System – AquaGRIS. The database of AquaGRIS will contain data on all cultured species, collected primarily through a purpose designed questionnaire and related to primary and secondary farmed types (Mair and Lucente, 2020). It also draws on some data from the country reports prepared for the global assessment mentioned earlier and production data from the FAO's aquaculture and fisheries database available through *FishstatJ* (FAO, 2019b). A range of different reports can be generated for different aspects of AqGR management, including species and country fact sheets.

AquaGRIS has application for a range of different stakeholders. Policy makers and resource managers can use the information as a basis for policy and strategy development and to monitor their implementation. Producers can find out what resources are available to them, their properties and even where to find them. Academics and breeders can use AquaGRIS to inform and prioritize their research and development and to communicate information about newly developed farmed types entering commercial production.

The current version of AquaGRIS is a prototype and, at the time of writing, contains detailed and searchable datasets on a few species such as common carp, Atlantic salmon, whiteleg shrimp, milkfish, Kappaphycus and Artemia, covering AqGR in over 40 countries. Work is on-going to develop a fully functional version of AquaGRIS that will include an improved user interface for data entry and validation expanded to collect data related to wild stocks of cultured species and also data that can be used to generate indicators for progress against the Global Plan of Action (see below). In the longer term it is hoped that AquaGRIS can be used to generate indicators of progress against SDG targets (e.g. SDG 2.5) and the targets and indicators of the CBD's Post-2020 Biodiversity Framework.

A Global Plan of Action

The global assessment identified over 40 needs and challenges. At the request of the Commission on Genetic Resources for Food and Agriculture, and following regional consultations, FAO developed a comprehensive Global Plan of Action (FAO, 2022) in response to these needs and challenges. The Global Plan of Action (GPA) is an internationally agreed framework aiming to enhance the management of AqGR to optimize their contribution to the promotion of food security and sustainable development, and alleviation of poverty. The GPA is a rolling plan, with a time horizon of ten years and is voluntary and non-binding. The GPA covers 21 strategic priorities under four priority areas and includes nearly 100 possible actions. It is understood that the priorities and important actions will differ from country to country depending on the status of countries' AqGR. The GPA can thus be considered as a menu of priorities and actions from which individual countries can identify key steps to take in relation to the status of their own genetic resources and the priorities for furthering conservation, sustainable use and development. The four priorities areas which are tailored to the characteristics of AqGR are: inventory, characterization and monitoring of AqGR; conservation and sustainable use of AqGR; development of AqGR for aquaculture; and policies, institutions and capacity building.

Other Resources under Development

In addition to the above-mentioned core resources, FAO is developing other initiatives to support communication and awareness raising on the importance of effective management of AqGR. During the implementation of the global assessment and the development of AquaGRIS it was recognized that the lack of harmonization and standardization of the use of terminology to describe AqGR was a significant constraint to raising awareness and understanding of the status of these resources. The effective use of AquaGRIS requires application of standard terminology based on a classification of farmed types that FAO has developed with a group of experts. To support AquaGRIS users and stakeholders in adopting and regularly using this terminology, FAO is also developing a thesaurus of terminology related to genetics in aquaculture that will be made available in future through the AquaGRIS interface and other media.

In response to the identified need for building awareness and capacity in relation to genetic management and improvement in aquaculture, FAO, in collaboration with the Norwegian Institute of Food, Fisheries and Aquaculture Research (Nofima), a leader and global pioneer in the application of genetics in aquaculture, have developed an online training programme on management and development of AqGR. The 18 modules for this basic course, including over 6 hours of video lectures (in short segments averaging 13 minutes) by some world leading experts, is targeting a range of stakeholders from students and industry representatives and resource managers, and cover a range of issues with a focus on genetic management and improvement in aquaculture. The content of the course is finalized at the time of writing and the course will be made available on line following the development of an appropriate delivery platform. FAO is also developing a number of case studies on genetic management in aquaculture and also guidelines for *ex situ in vitro* gene banking in aquaculture and guidelines for genetic management for stocking of captive reared farmed types into the environment (e.g. for conservation and fisheries enhancement).

Conclusions

The resources outlined above can be integrated and used together, through a stakeholder driven strategic planning process, to develop a national plan for advancing the management of AqGR as outlined in the figure below. The Framework can be used to conduct a form of broad audit of national or regional capacity across its five components, and to identify potential gaps that may necessitate capacity building. AquaGRIS can be used to construct an inventory of genetic resources in the

FAO resources for sustainable management of aquatic genetic resources in aquaculture

country that can inform development of priorities within a strategy. Based on the results from the Framework analysis and the national inventory of AqGR, priorities for a country can be identified from the elements of the GPA. Lastly, the other resources can be used to raise awareness of the importance of AqGR and potentially to build capacity in some areas.

The work of FAO in recent years has generated a comprehensive and holistic understanding of the global status of AqGR, identified some important needs and challenges, and generated some useful tools in response to these needs and challenges. However, these resources are yet to be widely adopted and utilized by countries. It is hoped that the growing awareness of the importance of biodiversity will be a catalyst for real actions on the ground in the countries and that countries and regions will begin to realize the present opportunity to secure the future supply of aquatic food through enhanced and effective management of AqGR.

References

FAO (2018) Aquaculture development. Development of aquatic genetic resources: A framework of essential criteria. FAO Technical Guidelines for Responsible Fisheries 5 Suppl. 9. Rome. 88 pp.www.fao.org/3/ca2296en/ca2296en.pdf

FAO (2019a) The State of the World's Aquatic Genetic Resources for Food and Agriculture. FAO Commission on Genetic Resources for Food and Agriculture Assessments. Rome. 291 pp. www.fao.org/3/ca5256en/ca5256en.pdf

FAO (2019b) Fisheries and Aquaculture Department, Statistics and Information Service. FishStatJ: Universal software for fishery statistical time series. Copyright 2019. https://www.fao.org/fishery/aquagris/home

FAO (2022) Global Plan of Action for the Conservation, Sustainable Use and Development of Aquatic Genetic Resources for Food and Agriculture. Commission on Genetic Resources for Food and Agriculture. Rome. https://doi.org/10.4060/cb9905en

Mair GC and D Lucente (2020) What are "Farmed Types" in aquaculture and why do they matter? FAO Aquaculture Newsletter No. 61: 40–42. www.fao.org/3/ca8302en/ca8302en.pdf#page=40