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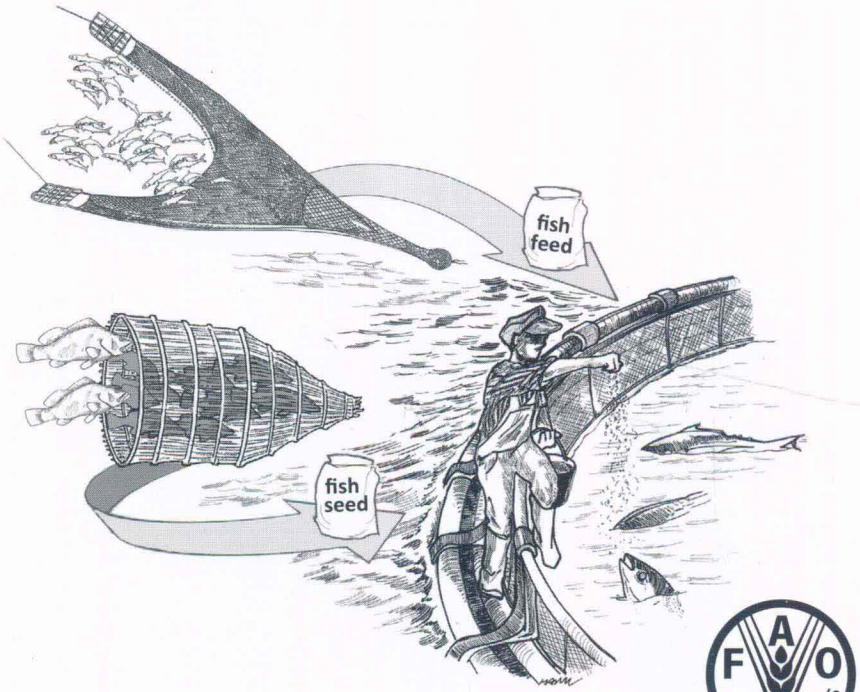
AQUACULTURE DEVELOPMENT

6. Use of wild fishery resources for capture-based aquaculture



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AQUACULTURE DEVELOPMENT

6. Use of wild fishery resources for capture-based aquaculture

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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PREPARATION OF THIS DOCUMENT

These technical guidelines on the use of wild fishery resources for capture-based aquaculture have been prepared by the Fisheries and Aquaculture Department of the Food and Agriculture Organization of the United Nations (FAO) under the coordination of Alessandro Lovatelli, Aquaculture Officer, Fisheries and Aquaculture Resources Use and Conservation Division. The production of the guidelines has been supported by the Government of Japan through a Trust Fund Project (Towards Sustainable Aquaculture: Selected Issues and Guidelines) and by the FAO Regular Programme. This project aimed to address selected key issues of sustainability in global aquaculture practices and development.

The initial discussions in preparation of the guidelines took place at the FAO expert workshop *Technical Guidelines for the Responsible Use of Wild Fish and Fishery Resources for Capture-based Aquaculture Production*, held in Hanoi, Viet Nam, from 8 to 12 October 2007. To develop these guidelines, eleven species-specific and two general review papers were prepared. They included both marine and freshwater examples and covered ecological, socio-economic and livelihood aspects of capture-based aquaculture.

The experts who attended the workshop and contributed in discussions and with inputs to the guidelines were: Don Griffiths (Ministry of Agriculture and Rural Development, Viet Nam), Øystein Hermansen (Norwegian Institute of Fisheries and Aquaculture Research, Norway), Robert Pomeroy (University of Connecticut-Avery Point, United States of America), Anders Poulsen (Ministry of Agriculture and Rural Development, Viet Nam), Victor Pouomogne (Institute of Agricultural Research for Development, Cameroon), Patrick Prouzet (Institut français de recherche pour l'exploitation de la mer, France), Kjell Midling (Norwegian Institute of Fisheries and Aquaculture Research, Norway), Mohammed Mokhlesur Rahman (Center for Natural Resource Studies, Bangladesh), Makoto Nakada (Tokyo University of Marine Science and Technology, Japan), Francesca Ottolenghi (Halieus, Italy), Magdy Saleh (General Authority for Fish Resources Development, Egypt), Yvonne Sadovy de Mitcheson (University of Hong Kong, Hong Kong Special Administrative Region), Colin Shelley (YH & CC Shelley Pty Ltd, Australia), Choi Kwang Sik (Cheju National University, Republic of Korea), Pham An Tuan (Research Institute for Aquaculture No. 1, Viet Nam), and Mark Tupper (WorldFish Center, Malaysia).

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ABSTRACT

The aquaculture of commercially valuable fish and invertebrate species is growing rapidly worldwide and has become a critically important additional means of production of freshwater and seafood at a time when many natural populations are declining in the wild. Capture-based aquaculture (CBA) is defined as the practice of collecting live material from the wild and its use under aquaculture conditions. It makes a significant contribution to aquatic production and livelihood generation. It encompasses a range of activities, from the capture of larvae, juveniles and subadults of desirable fish and invertebrate species as seed material for grow-out in captive conditions, to the taking of adults as broodstock and the use of wild-caught fishes and invertebrates for feed. Because CBA combines culture activities with exploitation of natural resources, there is potential for competition and conflict among fishing sectors that target different life history phases of target species and for impacts on the environment through overfishing or habitat damage. There are very few species produced by aquaculture that have little, or no, dependence on wild populations of target and non-target species. This means that the aquaculture of many species is still reliant on the sourcing of organisms from natural populations for some part of the operation, or with impacts to the wild fisheries in some manner as a result of that activity. The management and conduct of operations that have these effects, therefore, need to take account of both fishery and aquaculture considerations and good practices.

Until recently, CBA attracted little attention as an activity distinct from hatchery-based aquaculture (HBA) for monitoring and management consideration and indeed it has typically been treated in the same way as HBA. However, while the use of wild-caught resources for feed in aquaculture facilities is similar for both CBA and HBA, the heavy dependence of CBA on wild resources for seed and its implications for wild populations have been increasingly recognized in the last decade.

The long-term goal of most forms of aquaculture is eventually to transition from CBA to fully HBA; however, there is a range of biological,

socio-economic and practical reasons why this is unlikely to occur for many species, or in some cases, where this may even be undesirable or unnecessary. It must be recognized that CBA is an important and essential part of the aquaculture industry, but to ensure that its contributions lead to long-term societal and environmental benefits it must be operated sustainably and according to the FAO Code of Conduct for Responsible Fisheries and within the framework of an ecosystem approach to management. Recognizing that CBA will continue to provide important or essential inputs to aquaculture operations and that it is the starting point for the aquaculture of any species has led to the development of these technical guidelines for the responsible management and conduct of this activity.

Specifically, these guidelines address the actual and potential impacts of wild-seed harvest on target and non-target (bycatch), including threatened species, biodiversity and on the environment and marine ecosystem. The guidelines also consider capture and post-collection practices, grow-out, feed and broodstock, social and economic factors, and governance considerations. These technical guidelines identify CBA principles and guidelines for good practices and provide numerous illustrative case studies from a diverse range of species and fisheries.

ABBREVIATIONS AND ACRONYMS

CBA	capture-based aquaculture
CBF	culture-based fisheries
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
Code	Code of Conduct for Responsible Fisheries
COFI	FAO Committee on Fisheries
EAA	ecosystem approach to aquaculture
EAF	ecosystem approach to fisheries
EIFAAC	European Inland Fisheries and Aquaculture Advisory Commission
F	fishery mortality
HBA	hatchery-based aquaculture
ICES	International Council for the Exploration of the Sea
IUCN	International Union for Conservation of Nature
IUU	illegal, unreported and unregulated (fishing)
M	natural mortality
PL	post-larvae
RFMO	regional fisheries management organization

BACKGROUND

1. From ancient times, fishing from oceans, lakes and rivers has been a major source of food, a provider of employment and other economic benefits for humanity. Ocean productivity seemed particularly unlimited. However, with increased knowledge and the dynamic development of fisheries and aquaculture, it was realized that living aquatic resources, although renewable, are not infinite and need to be properly managed if their contribution to the nutritional, economic and social well-being of the growing world's population was to be sustained.

2. However, for nearly three decades, because of the dramatic increase of pollution, abusive fishing techniques worldwide, and illegal, unreported and unregulated fishing, catches and landings have been shrinking and fish stocks declining, often at alarming rates.

3. Stock depletion has negative implications for food security and economic development and reduces social welfare in countries around the world, especially those relying on fish as their main source of animal protein and income such as subsistence fishers in developing countries. Living aquatic resources need to be properly managed if their benefits to society are to be sustainable.

4. Sustainability of societal benefits requires a recovery of depleted stocks and maintenance of the still-healthy ones through sound management. In this regard, the adoption of the United Nations Convention on the Law of the Sea, in 1982, was instrumental. The law provides a new framework for the better management of marine resources. The new legal regime of the oceans gave coastal States rights and responsibilities for the management and use of fishery resources within the areas of their national jurisdiction, which embrace some 90 percent of the world's marine fisheries.

5. In recent years, world fisheries have become dynamically developing sectors of the food industry, and many States have strived to take advantage of their new opportunities by investing in modern fishing fleets and processing factories in response to growing international demand for fish and fishery products. It became clear, however, that many fisheries resources could not sustain an often uncontrolled increase of exploitation. Overexploitation of important fish stocks, modifications of ecosystems, significant economic losses, and international conflicts on management and fish trade still threaten the long term sustainability of fisheries and the contribution of fisheries to food supply.

6. In light of this situation, while recognizing that the recovery of depleted stocks is still urgent and avoiding depleting still-healthy stocks as important, FAO Member States have expressed the need to further develop aquaculture as the only immediate way to bridge the gap between the declining capture fisheries output and the increasing world demand for seafood.

7. Indeed, in the last three decades, aquaculture has recorded a significant and most rapid growth among the food-producing sectors and has developed into a globally robust and vital industry. However, aquaculture also has been shown at times to carry the potential to cause significant environmentally and socially adverse impacts.

8. Thus, the Nineteenth Session of the FAO Committee on Fisheries (COFI), held in March 1991, recommended that new approaches to fisheries and aquaculture management embracing conservation and environmental, as well as social and economic, considerations were urgently needed. FAO was asked to develop the concept of responsible fisheries and elaborate a Code of Conduct to foster its application.

9. Subsequently, the Government of Mexico, in collaboration with FAO, organized an International Conference on Responsible Fishing in Cancún in May 1992. The Declaration of Cancún, endorsed at that Conference, was brought to the attention of the United Nations Conference on Environment and Development Summit in Rio de Janeiro, Brazil, in June 1992, which supported the preparation of a Code of Conduct for Responsible Fisheries. The FAO Technical Consultation on High Seas Fishing, held in September 1992, further recommended the elaboration of a code to address the issues regarding high seas fisheries.

10. The One Hundred and Second Session of the FAO Council, held in November 1992, discussed the elaboration of the Code, recommending that priority be given to high seas issues and requested that proposals for the Code be presented to the 1993 session of the Committee on Fisheries.

11. The Twentieth Session of COFI, held in March 1993, examined in general the proposed framework and content for such a Code, including the elaboration of guidelines, and endorsed a time frame for the further elaboration of the Code. It also requested FAO to prepare, on a "fast track" basis, as part of the Code, proposals to prevent reflagging of fishing vessels which affect conservation and management measures on the high seas. This resulted in the FAO Conference, at its Twenty-seventh Session in November 1993, adopting the Agreement to Promote Compliance with International

Conservation and Management Measures by Fishing Vessels on the High Seas, which, according to FAO Conference Resolution 15/93, forms an integral part of the Code. It was also recognized and confirmed that issues of responsible aquaculture development and aquaculture sustainability should be addressed in the formulation process so that these be appropriately covered in the envisaged Code.

12. This implicit recognition of the importance of governance in aquaculture is underlined in Article 9.1.1 of the Code, which requires states to "establish, maintain and develop an appropriate legal and administrative framework to facilitate the development of responsible aquaculture". In addition, at the beginning of the new millennium there is growing recognition of the significant potential for and implications of the use of ocean and coastal waters for mariculture expansion. The outstanding issue in this area is that, unlike in capture fisheries, the existing applicable principles of public international law and treaty provisions provide little guidance on the conduct of aquaculture operations in these waters. Yet, experts agree that most of the future aquaculture expansion will occur in the seas and oceans, certainly further offshore, perhaps even as far as the high seas. The regulatory vacuum for aquaculture in the high seas would have to be addressed should aquaculture operations expand there.

13. The Code was formulated so as to be interpreted and applied in conformity with the relevant rules of international law, as reflected in the 10 December 1982 United Nations Convention on the Law of the Sea. The Code is also in line with the Agreement for the Implementation of the Provisions of this Law, namely the 1995 Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. It is equally in line with, *inter alia*, the 1992 Declaration of Cancún and the 1992 Rio Declaration on Environment and Development, in particular Chapter 17 of Agenda 21.

14. The development of the Code was carried out by FAO in consultation and collaboration with relevant United Nations agencies and other international organizations, including non-governmental organizations.

15. The Code of Conduct consists of five introductory articles: Nature and scope; Objectives; Relationship with other international instruments; Implementation, monitoring and updating; and Special requirements of developing countries. These introductory articles are followed by an article on General principles, which precedes the six thematic articles on Fisheries management, Fishing operations, Aquaculture development, Integration of fisheries into coastal area management, Post-harvest practices and trade,

and Fisheries research. As already mentioned, the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas forms an integral part of the Code.

16. The Code is voluntary. However, certain parts of it are based on relevant rules of international law, as reflected in the United Nations Convention on the Law of the Sea of 10 December 1982. In capture fisheries, the Code also contains provisions that may be or have already been given binding effect by means of other obligatory legal instruments among the Parties, such as the Agreement to Promote Compliance with Conservation and Management Measures by Fishing Vessels on the High Seas, 1993. In aquaculture, the provisions of the Code implicitly encourage participatory governance of the sector, which extends from industry self-regulation, to co-management of the sector by industry representatives and government regulators and to community partnerships. Compliance is self-enforced or enforced by peer pressure, with industry organizations having the ability to exclude those who do not comply and with governments only checking periodically.

17. The Twenty-eighth Session of the Conference in Resolution 4/95 adopted the Code of Conduct for Responsible Fisheries on 31 October 1995. The same Resolution requested FAO *inter alia* to elaborate appropriate technical guidelines in support of the implementation of the Code in collaboration with members and interested relevant organizations.

18. The expanding role and increasing contribution of aquaculture to economic growth, social welfare, as well as global food security was recognized and reiterated at international levels such as the 1995 FAO/Japan Conference on the Contribution of Fisheries and Aquaculture to Food Security, the 1996 World Food Summit, the 1999 Ministerial Meeting on Fisheries, the 2000 FAO/NACA (Network of Aquaculture Centres in Asia and the Pacific) Conference on Aquaculture in the Third Millennium and its Bangkok Declaration and Strategy, and most recently, the 2009 World Summit on Food Security.

19. The application of the ecosystem approach to fisheries and aquaculture as a strategy for the development of the sector contributes to the implementation of the provisions of the Code, thereby enforcing the technical, ecological, economic and social sustainability of the industry.

20. Article 7 of the Code of Conduct for Responsible Fisheries focuses on management of wild fisheries and Article 9 on aquaculture. FAO has produced a number of technical guidelines on specific issues of responsible fisheries

and aquaculture to assist Member States in the implementation of the Code. It is noteworthy that the *FAO Technical Guidelines for Responsible Fisheries No. 5 – Aquaculture Development* points out that detailed guidelines on specific issues and topics covered by Article 9 of the Code will be developed by FAO in collaboration with interested partners and identifies the need to provide specific guidelines on certain types of aquaculture systems.

21. These technical guidelines provide a framework for sustainable capture-based aquaculture (CBA) within the overall context of the FAO Code of Conduct for Responsible Fisheries. They provide general principles, guidance on evaluating the suitability of existing or proposed CBA and guidance on wild capture fisheries for CBA live material, inclusive of seed material and broodstock specimens.

22. As CBA involves both capture fishery and aquaculture components, the principles and guidance enshrined within both the ecosystem approach to fisheries and the ecosystem approach to aquaculture are highly relevant and form the foundation for these guidelines.

CONTENTS

1. INTRODUCTION

1.1 Capture-based aquaculture

Fisheries and aquaculture have been and remain important sources of food for humanity, as well as a provider of employment and other benefits. These two activities are often considered to be very different, often compared as the difference between hunting and farming. They are different in many aspects of what is done and who it is done by. Aquaculture certainly owes its origins to fishing, where wild fish or shellfish were trapped or settled in ponds or cages and then cultured to a larger size. Indeed, such systems continue to exist today and still provide significant amounts of the global production from aquaculture. The targeted capture of seed or broodstock for aquaculture operations is a more recent development and one that can result in impacts on wild populations, their habitats and non-targeted species. Another well-known linkage between capture fisheries and aquaculture is the direct use of wild fish to feed cultured animals. Although this may be viewed solely as a fisheries management concern, unrelated to the aquaculture operation, the interdependence of the fisheries and aquaculture must be recognized in order to manage the two effectively.

Previously, these interdependencies between fisheries and some forms of aquaculture had not been widely acknowledged as a distinctive activity and were simply considered to be a form of aquaculture, unrelated to the conduct or management of capture fisheries. The form of aquaculture that is directly linked to capture fisheries operations is termed "capture-based aquaculture" (CBA) and it can be considered as the practice of collecting live material from the wild and its subsequent use in aquaculture. It is, therefore, an aquaculture operation that involves some form of wild capture fishery activity for deriving seed material, broodstock specimens or feed up to the point of sale or trade.

Because of its linkage to capture fisheries, it is now recognized that CBA can cause ecosystem effects, such as contributing to or even drive overfishing, and negatively impacting non-target species and habitats. When badly managed, such CBA can affect ecosystem functions and services with negative environmental, social and economic consequences. In the case of CBA, which includes significant wild capture, the practice can also contribute to threats to species from overfishing. In such cases, CBA is or has been pursued unsustainably, with negative impacts on wild animal resources, the environment and on some sectors of society.

It is also clear that responsible CBA can contribute positively to livelihoods and economies, as demonstrated through examples of sustainable CBA. Capture-based aquaculture is the necessary first step in the development of fully closed-cycle aquaculture. It can provide a significant supplement to the production of aquatic resources, an outcome of increasing importance given the declining capture rates in many wild stocks of fishes and invertebrates. In doing so, CBA can be a significant economic activity, providing many livelihoods and producing food in a manner that can be conducted sustainably.

The ecosystem approach to fisheries (EAF) and the ecosystem approach to aquaculture (EAA) have three main objectives: (i) ensuring human well-being; (ii) ensuring ecological well-being; and (iii) facilitating the achievement of both, i.e. effective governance of the sector/areas where aquaculture occurs and has potential for development. In these guidelines, the term "sustainability" refers to the potential for long-term maintenance of human well-being, which in turn depends on the well-being of the natural world and the responsible use of its limited resources. Sustainable CBA, therefore, demands both sustainable practices at the level of the target species, as well as taking responsibility for its interactions in the ecosystem context.

1.2 Terms and definitions

Given that there is no existing definition for CBA, that CBA is a significant activity, and that CBA is not specifically incorporated in the definition of "aquaculture" by FAO, there is a need for a concise and clear definition for use in these guidelines. A suitable starting point is the definition developed by Ottolenghi *et al.* (2004), which states: "Capture-based aquaculture is the practice of collecting 'seed' material – from early life stages to adults – from the wild, and its subsequent on-growing in captivity to marketable size, using aquaculture techniques."

While this definition makes an important contribution to advancing the understanding of CBA, it is largely focused on the grow-out phase of aquaculture. There is a need for a broader definition that can adequately incorporate the wider range of CBA activities and issues, e.g. the capture (i.e. collection) of broodstock or seed material from the wild for aquaculture use.

The following term is proposed as a definition of CBA: "Capture-based aquaculture is the practice of capturing or collecting live material from the wild and its subsequent direct use in aquaculture."