# Genetic resources for aquaculture: ownership and access

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## Introduction

The regulations, protocols and practices that govern access to and ownership of the world's genetic resources (microorganisms, plants and animals) are complex and are still evolving rapidly. In order to appreciate the current situation with respect to aquatic genetic resources and to forecast likely future trends, we must first consider the recent history, the current picture and future scenarios for genetic resources in general. Up to the 1980s, most genetic resources were considered as being in the public domain: a common heritage of humans, with open access and without intellectual property rights (IPR). This view has since changed progressively as various parties have sought ownership of and regulated access to genetic resources: *e.g.* the national sovereignty acquired over all biodiversity within national boundaries by Parties to the Convention on Biological Diversity (CBD) (CBD, 1994; TINKER 1995), the recognition of farmers' and breeders' rights over distinct varieties and breeds, and attempts by indigenous peoples to secure rights to the genetic resources upon which their livelihoods have traditionally depended and to their local knowledge about these resources (*e.g.* GADGIL *et al.*, 1993; Crucible Group, 1994). As a further illustration of this trend towards defined ownership, it was suggested at the fifth session of the Global Biodiversity Forum, held

1-3 November 1996 in conjunction with the third Conference of the Parties of the CBD in Buenos Aires, that the term "wild resources/species" should be replaced with the term "non-domesticated resources" so as to avoid giving the impression of no ownership of such resources.

These developments and debates have been and continue to be dominated by consideration of plant genetic resources, especially those for the major human food crops and for species with proven or potential worth for pharmaceutical use. The resulting literature on plant genetic resources is large and complex and is growing rapidly. A review of this is beyond the scope of this paper, but selected references are appended to illustrate the scope of work still needed for aquatic genetic resources. Public opinion might swing away from widespread privatization of genetic resources if the exercising of ownership and access rights is ultimately found to be not worth its cost. In other words if, as is likely to be the case for many species, the "pot of gold" for genetic resource owners is small and the cost of collecting payments is large. For example, it was estimated at a recent international consultation on fish genetic resources (PULLIN and CASAL, 1996) that of the US$700 million known profits from global trade in plant seeds in 1993, assuming (optimistically) that about 10% of these derived from materials subject to the provisions of the CBD, there would be only about US$70 million in profits to be shared among source countries and probably only about US$7 million to be shared as royalties.

For most aquatic genetic resources, significant royalties and cost-effective administration and collection of these are even harder to envisage. It is, however, understandable that biological resource-rich and cash-poor countries must seek to maximize their utilization of and returns from their genetic resources. Private sector interests, especially in the more developed countries, are pushing for more privatization and patenting of biological material and processes, mainly on the premise that these measures are necessary for the further investments in discoveries and developments that will produce from such material and processes the maximum benefits for humankind. There are, however, counterarguments. These are largely ethical but some are economic: for example, that patents do not normally stimulate invention or investment in more research to provide further advances and benefits (BUSCH, 1995). The consequent polarization of views held up the signing of the CBD by

some parties, on the grounds that this would damage the interests of their biotechnology industries. It has also given rise in Europe, most recently in 1996, to controversial proposals for European Parliament and Council Directives on the legal protection of biotechnological inventions (*e.g.* Commission of the European Communities, 1996). The 1996 proposal is currently being opposed, on ethical and moral grounds, as an undesirable step towards the privatization of nature and lifeforms and as a constraint to research (DALTON *et al.*, 1997). An earlier directive on the patenting of biological material (published on 12 October 1988) was rejected by the European Parliament on similar grounds, after strong protests by nongovernmental organizations, developing-region representatives and farmers' organizations (GRAIN, 1995). For at least the next decade, it is unlikely that these controversies will be fully resolved. Moreover, although focused on plants and microorganisms, the emerging protocols and mechanisms governing ownership of and access to genetic resources will probably be deemed to apply also to livestock and to aquatic animals.

The former FAO Commission on Plant Genetic Resources has now become the FAO Commission on Genetic Resources for Food and Agriculture (CGRFA) (FAO, 1995a). Its 1997 meeting will include consideration of livestock genetic resources. Aquatic genetic resources will be on its agenda for future meetings. FAO has already established a program for the Management of Global Animal Genetic Resources, meaning farm livestock, and a CD-ROM has already been produced (FAO, 1995b; FAO/Unep, 1995; IDAD-FAO, 1996). The FAO CGRFA is renegotiating its International Undertaking on Plant Genetic Resources with the holders in trust of collections of genetic resources, especially with those crop centers of the Consultative Group on International Agricultural Research (CGIAR) that have ongoing agreements with FAO by which "designated" germplasm of plants is held *ex situ*. The purpose of this renegotiation is to bring the Undertaking and these agreements more into harmony with the CBD. The CBD's Article 15 covers access to genetic resources. Its key elements, paragraphs 4 and 5, require that access shall be on "mutually agreed terms" and subject to "prior informed consent". These terms are intended to apply to the Contracting Parties, which, under the CBD, are sovereign States. However, this approach can be extended to other parties (institutions, groups or individuals)

(GLOWKA, 1995). The interpretation of Article 15 has been discussed at length by GLOWKA *et al.* (1994).

## Genetic resources in aquaculture research and development

Genetic resources for aquaculture are, compared with genetic resources for agriculture, poorly documented, and their ownership and arrangements for access are poorly defined. In 1992, Iclarm convened an international meeting on International Concerns in the Use of Aquatic Germplasm (Iclarm, 1992). This meeting arose largely because of the success of Iclarm and its Philippine and Norwegian partners in pioneering a selective breeding approach to genetic improvement in tropical aquaculture: the Genetic Improvement of Farmed Tilapias (Gift) Project, using the Nile tilapia (*Oreochromis niloticus*) as a case study (GJEDREM and PULLIN, 1986; EKNATH *et al.*, 1993). In addition to using farmed Asian strains acquired in Asia and derived from historical introductions originating from Africa and within Asia, the Gift project team, supported by UNDP, collected new founder stocks from Egypt, Ghana, Kenya and Sénégal. These collections were made five years before the entry into force of the CBD. This 1992 meeting's recommendations did not address thoroughly the ownership of and access to such aquatic genetic resources. Indeed, a separately published report (ROSENDAL, 1992) highlighted its lack of clarity with respect to IPR and access to fish genetic resources. Its recommendations to Iclarm included the following:
"... that (a) Iclarm continue basic research on the genetic improvement of farm fishes to secure and improve upon the gains that have already been made and (b) the current breeding strategy [i.e. selection] is the most appropriate for maintaining genetic diversity and ensuring ease of access to the material [*i.e.* it is difficult to patent]. It should therefore be continued ... [and that] ... as demand for seed increases, it will be necessary for Iclarm to fully

transfer seed production and distribution responsibilities to national bodies."

An FAO Expert Consultation on Utilization and Conservation of Aquatic Genetic Resources (FAO, 1993) then made a large number of recommendations, though not on access and ownership *per se*, and within a lengthy text and emphasized, among many other issues, the need for policy and regulations to address: "... the rights and needs of communities of users and donors to ensure that the benefits they obtain from aquatic animal genetic resources are not undermined by their distribution to others, and by the use of this germplasm by others now or in the future, and that there be a means of compensation for their contribution [...] (and) [...] ways in which recipients and users of collected germplasm may pass on the benefits derived from the use of the germplasm, and information from genetic studies, to the donor/host country scientists, local communities, farmers, fishers, and indigenous people ..."

The report of a subsequent external "Stripe Study" of genetic resources in the CGIAR (TAC/FAO 1994) recommended that: "IARC's [International Agricultural Resource Centers] involved with genetic resources of trees, animals and aquatic species should not accumulate collections of these organisms beyond the small number necessary to conduct specific research at the centres which cannot be conducted in the countries".

Iclarm was subsequently included in an external review of all CGIAR genebank operations in 1995 (SGRP, 1996 and *in press*). The review was dominated by consideration of large *ex situ* crop genebanks. Its specific recommendations to Iclarm, though useful for setting future directions in research and training (for example, realism in what can be genebanked and by what method-cryopreservation was recommended), did not address the issues of ownership of and access to germplasm used by Iclarm and its partners for research purposes. It was not clear whether limited collections of germplasm used for fixed term research projects (for Iclarm and its partners, live tilapia broodstock and cryopreserved tilapia sperm and some marine invertebrates), could be construed as genebanks *per se*. In 1996, the Iclarm Board of Trustees took a policy decision that these are germplasm collections for research purposes, kept for the duration of the work for which they are

needed, and are not genebanks per se that will be maintained indefinitely. A document stating Iclarm's policy on these collections and on intellectual property rights pertaining to aquatic genetic resources is being prepared for publication. The basis of this policy is to ensure compliance with the provisions of the CBD and to preclude claims of private ownership over germplasm held or developed by Iclarm and its partners and over related information.

## Documentation of aquatic genetic resources: a prerequisite for defining ownership and access arrangements

Aquatic genetic resources are generally poorly documented except where biochemical genetic characterization methods have been used for species and groups of special significance in aquaculture and fisheries; *e.g.*, for tilapias, FRANCK *et al.*, 1992 and MACARANAS *et al.*, 1996 and for salmonids, BARTLEY *et al.*, 1992. CARVALHO and PITCHER (1995) have provided a substantial compilation of the methods available, but this is a fast developing field in which new and modified approaches are frequently described; *e.g.*, see FALK *et al.* 1996. Despite these powerful characterization tools, the accelerating pace of germplasm enhancement for aquaculture and increased interest in exchanging germplasm are creating a situation where accurate, and up-to-date accessible information about the location and status of aquatic genetic resources is not generally available. As a contribution to solving this problem, PULLIN (in press) suggested the establishment of more fish breeder's networks or associations through which public and private sector members could share germplasm and related information. These would, of course, need time, money and appropriate political and economic climates to be established and maintained. Researchers and others reporting on aquatic genetic resources and aquaculture research and development could also help by specifying more exactly the genetic

status of their fish. Researchers often give limited information on their experimental fish: usually just the species or subspecies and its "origin". It would be better in aquaculture research publications and in reports about farm performance and about trade in farmed aquatic produce, to specify the "provenance" of the material used. Provenance is a well-established concept in forestry, geology and in the world of art and antiques. In forestry, the term "provenance" refers to clonal or seed material and defines the geographical location (and hence the environment): "... in which the parent trees grew and within which their genetic constitution has been developed through artificial and/or natural selection..." (BURLEY and WOOD, 1976). The origin of material may be different. The provenance concept could be applied to tilapias to help to specify the history of material used in research and production. For example, the origin of all *Oreochromis urolepis hornorum* must be the Wami river, Tanzania or possible Zanzibar, but as this species has been moved around the world, the provenance of a given stock of fish could be institutions and farms in Brazil, Côte d'Ivoire, Israel, Malaysia, the USA and other countries (PULLIN, 1988).

## Future possibilities

The conservation and use of aquatic genetic resources are interdependent as has been repeatedly stressed in recent publications (*e.g.*, MCANDREW *et al.*, 1993; MACLEAN and JONES, 1995; HARVEY, 1995; PULLIN, 1996 and in press; PULLIN and CASAL, 1996). However, ownership of and arrangements for access to aquatic genetic resources remain very poorly defined. As a result of its 1995 consultation (PULLIN and CASAL, 1996), Iclarm and FAO have proposed an international policy conference in 1998 to explore approaches and to develop tools and methods for policymakers in this field. Also in 1998, the CBD will put freshwater biodiversity high on its agenda for the first time since its entry into force. This could initiate actions among the Parties, FAO,

NGOs, the CGIAR, the private sector and others from which clearer arrangements and protocols for aquatic genetic resources might emerge. This is likely to be a lengthy process because genetic resources for aquaculture will probably continue to command less attention than those for agriculture, forestry or drug use. An indication of this is that the CBD, in working towards its first legally binding protocol, on biosafety, is restricting the scope of the protocol to genetically modified organisms (GMOs): meaning, those produced by genetic manipulation. This restriction ignores the fact that unmodified or wild alien aquatic species and aquatic breeds developed by conventional breeding methods can also be biohazards.

While a higher profile for aquatic biodiversity and genetic resources is awaited and while insufficient sharing of data and experiences persists, policymaking and the framing of workable and equitable arrangements for their conservation and use are likely to remain *ad hoc*. Institutions, individuals, networks and the private sector will increasingly seek to document, evaluate and exchange aquatic germplasm. Some will proceed carefully and responsibly, with due regard to biosafety and quarantine [for example, as in the protocols and Manila Resolution of the International Network for Genetics in Aquaculture (Inga) (Inga, 1997)]. Others will act opportunistically and without adequate safeguards, posing threats to some aquatic biota and their habitats and to some pre-existing aquaculture and fisheries. Such moves will further hinder the gathering and sharing of accurate, up-to-date information on genetic resources for aquaculture (PULLIN, in press).

What can be done to improve this situation? The solution lies mainly in the hands of the national governments that are Parties to the CBD and to other related conventions and trade agreements. Only they can ultimately implement the national biodiversity strategies and regulations required. This difficult task requires recognition of the interests of many diverse stakeholders. Sound policies for aquatic genetic resources are therefore urgently needed.

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