

# **GIFT: The Story Since Leaving ICLARM (now known as The WorldFish Center)**

**Socioeconomic, Access and Benefit Sharing and  
Dissemination Aspects**

Raul W. Ponzoni, Hooi Ling Khaw and Hoong Yip Yee





# GIFT: The Story Since Leaving ICLARM (now known as The WorldFish Center)

Socioeconomic, Access and Benefit Sharing and  
Dissemination Aspects



By Raul W. Ponzoni, Hooi Ling Khaw and Hoong Yip Yee

The WorldFish Center  
Penang, Malaysia  
E-mail to Raul W. Ponzoni: [r.ponzoni@cgiar.org](mailto:r.ponzoni@cgiar.org)

November 2010



FRIDTJOF NANSENS INSTITUTT  
FRIDTJOF NANSEN INSTITUTE

**Copyright © Fridtjof Nansen Institute 2010**

**Title**

GIFT: The Story since Leaving ICLARM (Now Known as The WorldFish Center – Socioeconomic, Access and Benefit Sharing and Dissemination Aspects

**Publication Type and Number**

FNI Report 14/2010

**Pages**

47

**Authors**

Raul W. Ponzoni, Hooi Ling Khaw and Hoong Yip Yee

**ISBN**

978-82-7613-602-9-print version  
978-82-7613-603-6-online version

**ISSN**

1504-9744

**Abstract**

The aim of the overall project of which this report is part is to identify possible solutions for regulating access to aquatic genetic resources and legal protection of the results of research and development in aquaculture using such resources. The case study of the collaborative program on Genetic Improvement of Farmed Tilapias (GIFT) serves as a basis for comparison with two other case studies from Norway on salmon and cod.

This study aims to address the following questions: How has the legal regime for GIFT material developed since leaving WorldFish? How has this affected the use and dissemination of GIFT material by the aquaculture sector (private and public sectors)? How has the transfer from WorldFish affected access and benefit sharing of GIFT material? And what are the effects on further developments and innovation of this breeding material? The report concludes that there is no doubt that the GIFT project has had an impact worldwide. Both the technology and the genetically improved fish have been widely distributed and are now known. Whereas we believe that it is fair to say that in many instances the improved fish have reached and benefitted the poor, it is also an area where gross mistakes were made. Such mistakes separated events from a path that could have benefitted the poor much more. The first miscalculation was to assume that GIFT Foundation International Inc. (GFII) was going to rapidly become financially self-reliant and that it did not require further support. This mistake led to another even greater error of judgement, the alliance between GFII and GenoMar, whereby the latter profit-oriented company obtained the right to breed and market GIFT. This decision brought about a change of focus of GFII from breeding and dissemination of GIFT fish to poor and small scale farmers to meeting the business objectives of GenoMar instead.

**Key Words**

Aquatic genetic resources, farmed tilapia, access and benefit sharing, ABS

**Orders to:**

Fridtjof Nansen Institute  
Postboks 326  
N-1326 Lysaker, Norway

Phone: (47) 6711 1900  
Fax: (47) 6711 1910  
Email: [post@fni.no](mailto:post@fni.no)

Internet: [www.fni.no](http://www.fni.no)

## Contents

Project Context	1
The Sustainable Innovation in Aquaculture Project	1
Objectives of the Case Study	2
Introduction	3
Brief Outline of the Distribution of GIFT at the End of the Project	3
Detailed Considerations about the Multiplication and Dissemination of GIFT Immediately after Project Finalization	4
The Situation in Perspective	4
The Public Sector and GFII	5
Sustainability of program initiated by public sector	5
Development of other improved tilapia strains	6
Contrasts between the Public Sector and GenoMar	7
Change in focus of farmer clients and beneficiaries	7
Divergence in research agenda, goals and priorities	7
Lessons Learned from the Creation of GFII and its Alliance with GenoMar	7
WorldFish Work with GIFT and Its Dissemination	8
Origin of WorldFish GIFT	8
Dissemination and Monitoring of the Destiny of WorldFish GIFT to Partner Countries	9
Objectives of the survey and maintenance of a GIFT inventory	9
The problem	10
Approach and activities	10
Results	11
Brief Account of the Status of WorldFish GIFT in Each Country	13
Bangladesh	13
Brazil	14
China	15
Malaysia	16
Philippines	16
Sri Lanka	17
Thailand	18
Vietnam	18
WorldFish and the Dissemination of GIFT to Africa	20
Concluding Remarks	20
Acknowledgements	21

Appendix 1 Amended and Restated Memorandum of Agreement	23
Appendix 2 Sample of WorldFish publication from work with GIFT	37
Appendix 3 Questionnaire	42
Appendix 4 Policy on the transfer of GIFT from Asia to Africa by the WorldFish Center	43
References	47

## **Project Context**

### **The Sustainable Innovation in Aquaculture Project**

The case study was conducted under the umbrella of the ‘Stimulating sustainable innovation in aquaculture’ (*Project number 187970/S10 funded by the Research Council of Norway and coordinated by Nofima Marine*). It corresponds to Work Package 2, the second deliverable in the project.

Access to genetic resources pertaining to aquaculture is vital for the future development of this important food production sector. Aquaculture plays an important role in national economies from the point of view of employment, its share in gross domestic product and providing protein to increasing populations. Currently, relevant types of legal regimes at national and international levels are under development and meanwhile domestic and external activities take place in a legally unclear way.

The aim of Work Package 2 is to identify possible solutions for regulating access to genetic resources and legal protection of the results of research and development using such resources. Systematic knowledge on how corporate strategies and international and national regulations affect access to, and equitable sharing of, benefits rising from the use of genetic resources will be acquired. This will be done by combining biological competence on the characteristics of genetic resources (Nofima Marine) with legal and political science competence on resource management (Fridtjof Nansen Institute). The case study of GIFT will serve as a basis for comparison with two other case studies from Norway on salmon and cod.

The foci for this work package will be the aquaculture sector, the international regulations on access and benefit sharing emanating from the Convention on Biological Diversity (CBD) and the regulations relating to intellectual property rights emanating from the Trade Related Aspects of Intellectual Property Rights (TRIPS) under the World Trade Organisation. We will investigate strategies and regulations relating to this material both in terms of export, import, domestic dissemination and exchange of genetic material with a particular focus on genetic improvement of resistance to diseases. The investigation includes various forms of ownership of genetic resources/breeding programs: governmental, private, domestic, external and multinational.

The overall Work Package 2 objectives are:

1. to provide an overview and assessment of, options available for the domestic access to aquatic genetic resources and innovation in aquaculture breeding.
2. to identify potential ways and means to promote a sustainable balance between access and legal rights to aquatic genetic resources.
3. to contribute to the understanding of the options available for fish farmers, - breeders and other stakeholders in the aquaculture sector.

The Work Package 2 is carried out by Nofima Marine and the Fridtjof Nansen Institute (FNI) in Norway in co-operation with Dr. Raul Ponzoni at the WorldFish Center, Penang, Malaysia.

### **Objectives of the Case Study**

The GIFT study involves the following dimensions:

1. How has the legal regime for GIFT material developed since leaving WorldFish?
2. How has this affected the use and dissemination of GIFT material by the aquaculture sector (private and public sectors)?
3. How has the transfer from WorldFish affected access and benefit sharing of GIFT material?
4. What are the effects on further developments and innovation of this breeding material? This includes the issue of rights to propagating material.

The findings in the report will be compared with the two Norwegian cases, which will be developed and written by Kristin Rosendal and Morten Walloe Tvedt (FNI), and Hans B. Bentsen and Ingrid Olesen (Nofima). The two Norwegian cases are on Atlantic salmon and Atlantic cod:

WP2a) Comparative study with European focus: Atlantic salmon and Atlantic cod: Access and property rights.

WP2b) Comparative study with global focus: Atlantic salmon and Nile tilapia from the GIFT project: Access and property rights.

The case study of GIFT will form the basis for the comparative analysis in WP2b) carried out by the Fridtjof Nansen Institute and Nofima Marine.

## **Introduction**

The history and evolution of the GIFT program has recently been the subject of thorough reviews (e.g. Gupta and Acosta 2004, Asian Development Bank 2005, Acosta and Gupta 2010). For that reason we will trace it only very briefly here.

Responding to challenges that the developing world faces regarding food security and malnutrition, during the last two decades there have been increased efforts to enhance production traits of commercially important aquatic animal species by genetic means. From the 1980s to the present, several institutions in developing countries have been engaged in such research and development activities. It is generally recognized that the collaborative program on Genetic Improvement of Farmed Tilapias (GIFT) has spurred the development of several other tilapia and carp breeding programs that now exist in numerous developing countries. The GIFT program was a collaborative research and development undertaking conducted by the WorldFish Center (formerly, International Center for Living Aquatic Resources Management, ICLARM) and its partners from the Philippines and Norway, aimed at developing methodologies for the genetic improvement of tropical finfish of aquaculture importance. The GIFT project demonstrated that selective breeding was a feasible, cost effective, and sustainable approach to the genetic improvement of tropical finfish. It also confirmed the importance of a multidisciplinary approach that enabled the assessment of economic viability, social acceptability, and environmental compatibility, thus, creating confidence among planners and administrators. This later facilitated the transfer of the research and development findings to farming systems in a host of countries.

Overall the GIFT project was very successful. In simple terms, it achieved two major objectives:

1. The adaptation and further development of selective breeding technology that can be effectively used with aquatic animals, and
2. The creation of an improved strain (GIFT), of superior productivity and highly attractive to farmers.

In the sections that follow we discuss the various ways in which this unique tilapia strain has been disseminated.

## **Brief Outline of the Distribution of GIFT at the End of the Project**

At the completion of the GIFT project in 1997, after six generations of selective breeding, representatives from all the GIFT families were made available to partners interested in follow up breeding work with GIFT. For instance, in this way, the Bureau of Fisheries and Aquatic Resources (BFAR) in the Philippines and WorldFish in Malaysia received GIFT stock (the work with GIFT and its dissemination by WorldFish are dealt with separately in a later section of the report). At the same time, rights to the fish were given to a newly created non-profit organization, GIFT

Foundation International Inc. (GFII) in 1999. This organization was established to continue the research, market the fish, and the idea was that it would use the revenues to conduct further research with tilapia. However, GFII failed to rapidly reach a stage of economic self-sufficiency, as one could have predicted given the relatively early stage of development of the tilapia industry in Philippines and in Asia in general. This early stage of development was especially evident (and still is) in relation to the willingness of hatchery managers to pay higher prices for brood stock of superior genetic merit. In an attempt to remedy this, GFII entered a collaborative program with the Norwegian private company GenoMar ASA. By virtue of the agreement made, GenoMar acquired the commercial rights to the GIFT strain and received representatives from all the latest families. Since then, GenoMar has continued with the breeding program and has been very active marketing the fish. GenoMar entered into commercial ventures using their trademark name, GenoMar Supreme Tilapia, in the Philippines, Brazil and China. The company has continued research and development activities that began under GFII, but these have now been privatized.

It may be argued that access to the genetically improved fish breeds needs to be kept available to the public, to benefit those who need it most. Otherwise, the advances made, the improvements in productivity, will be available only to those who can afford them, together with the associated inputs such as specialised feed. This could endanger the livelihoods of the millions of people in countries such as the Philippines who rely on aquaculture. If public access to breeds such as the improved tilapia can be maintained, then these livelihoods may continue to flourish. We discuss this issue at greater length later in the report.

### **Detailed Considerations about the Multiplication and Dissemination of GIFT Immediately after Project Finalization**

This section is largely based on material in the publication by Acosta, Sevilleja and Gupta (2006).

#### **The Situation in Perspective**

Similar to crops where agricultural research began with the public sector, the initial research in the Philippines with tilapias, a freshwater fish gaining prominence in fish farming and global food status at the time, was pioneered by public sector institutions (international and regional organizations based in Philippines, as well as national institutions). During the late 1970s to mid 1990s these public sector institutions played a leading role in undertaking studies that eventually led to the development of genetic improvement technology, improved tilapia strains, and in facilitating the transfer of these strains to farmers. During the late 1990s, in view of the progress made on genetic improvement, advancements in farming technology and increased domestic and global demand for tilapias, there was an increased participation of the private sector (commercial local tilapia hatcheries) as multipliers in the production and dissemination of improved tilapia breeds in the country. During

this period, the established infrastructure and competencies (technology developed in the GIFT project, the genetically improved tilapia strain from generation 10 of selective breeding, trained project staff, breeding facilities, network of private sector tilapia hatcheries and grow-out farmers) of GFII caught the attention of a private commercial company based in Norway (GenoMar ASA). GenoMar also visualized the potential for the significant commercial gains that could be achieved from the GIFT strain. This stimulated GenoMar's interest in developing a 'collaboration'. At that time GFII, with its existing collaborations with private sector hatcheries, also recognized that establishing a formal alliance with a private sector company such as GenoMar could enable the organization to advance its selective breeding research, acquire a competitive edge in the market (both local and international), and most importantly, improve its financial capability which was not in good shape at the time.

With the establishment of the GenoMar-GFII alliance and the GenoMar-accredited hatcheries, the Philippine tilapia industry entered a phase where the traditional public sector institutions and its partner farmers were not the only actors involved in the program for tilapia breeding and dissemination of improved seed.

## **The Public Sector and GFII**

### *Sustainability of program initiated by public sector*

Despite the critical importance of genetics research and the expected benefits and returns from the investment, sustained funding remains a major challenge for public sector breeding programs. External support to the GIFT project came to an end in 1997 and the institutional partners established the GFII in an attempt to ensure the continuation of the project's activities. The Philippine National Tilapia Breeding Program was initially conceived as a strategy for continuing the GIFT research. However, none of the GIFT project's participating institutions from the public sector was ready at that time and had the necessary resources to continue the program. The GIFT project's institutional partners were skeptical about handing it over to a purely commercial private sector company. They feared that such a company might not have the capacity to maintain the genetic quality of the improved germplasm. Also, there were concerns in relation to the potential difficulty that might arise in furthering the public sector's development goals once the program was privatized at an early stage. Policies were lacking to guide any process involving the interaction of public and private sectors in this area.

A non-profit, private foundation was preferred. It was hoped that this would enable the institutional partners of the GIFT Project to maintain relations with the foundation and fulfill their objective of serving the needs of the small-scale and poor farmers. Other options were considered for continuing the program. However, there was awareness that the decision had to take into account whether the resulting institution (public, private or a combination of the two) that would continue the GIFT program had the capacity to sustain the genetic gains achieved, deliver the products to end-users, and provide the support and extension services needed to accompany the distribution of the product.

The original objective for which GFII was established was to continue with the selective breeding program, and undertake commercial dissemination of the strain. Assuming that GFII would rapidly develop financial viability proved to be a gross error of judgement. This was quite unlikely to happen in a developing country, for an industry that was far from reaching a stage of maturity, and with a hatchery sector where there was no culture of paying greater prices for stock of greater genetic merit. In the vulnerable financial situation in which GFII was taking its first steps, the alliance with GenoMar appeared as the solution to their economic worries. However, a side effect of the agreement was that GFII's efforts drifted away from the original ones, to servicing and performing the contracted research and development with GenoMar. Given the Foundation's commitment to contracted research with GenoMar, resources (facilities and staff) needed to accomplish its own goals, were diverted. The Foundation's contractual agreement with GenoMar was for a limited period (5 years, see Appendix 1), so it never provided long term certainty or assurance of sustainability. The result was the GFII's original objective was neglected. Noting the general expectation that products of public sector genetics research must be sustained and should result in the greatest possible public benefit, critics have raised the question of whether forming an alliance with a private and commercially oriented company such as GenoMar was an appropriate route for achieving sustainability and the original goals of GFII. Based on what has happened, our position is that it was not an appropriate route to attain the goals of GFII.

#### *Development of other improved tilapia strains*

As a result of the agreement reached among founding institutions of the GIFT project, GFII was granted the rights to use the GIFT trade name and to commercially disseminate the improved strain in the country. Meanwhile, to enable institutions such as BFAR to fulfill their mandate to improve the livelihood of local farmers through provision of improved tilapia strains, this public sector institution also developed, using the GIFT strain as one of parent stocks, its own improved strain which came to be known in the Philippine market as EXCEL.

The development and dissemination of various improved tilapia strains in the country was hailed as a significant milestone in the Philippine tilapia industry. It was hoped that this could help bring about the targeted incremental production of the tilapia sector. Another perceived advantage was that this could lead to increased diversity of improved tilapias available in the local market. Hence, it could encourage competition and prevent monopoly of single local or foreign firm.

The dissemination of improved tilapia strains did not necessarily take place in a rational manner. To a large extent, the public and private sectors targetted the same market niche, and both were concentrating dissemination in those rural regions where most of the medium to large scale tilapia farmers were located. Market segmentation might have been one way that public and private sectors could have exploited their asset-complementarities, establishing agreements or an understanding in which

the public sector serves resource-poor farmers and leaves commercial farmers to be serviced by the private sector.

### **Contrasts between the Public Sector and GenoMar**

GenoMar's entry in the overall program for genetic improvement and dissemination of improved tilapia strains in the Philippines introduced a new dimension to the aquaculture industry in the Philippines. However, some issues emerged as a consequence.

#### *Change in focus of farmer clients and beneficiaries*

Since there are more opportunities for greater volume of sales and commercialization in medium to large-scale farmers, the private sector as exemplified by the alliance of GFII with GenoMar, focused more on these groups of farmers, rather than on the small, subsistence and resource poor farmers.

#### *Divergence in research agenda, goals and priorities*

There is a difference in the approach to genetic research between the public and the private sector. Whereas in the public sector phase of research collaboration (GIFT project) which focused on traditional selective breeding, all results were made public and openly discussed, research in the private sector in this particular instance is secretive and it is not possible to obtain clear descriptions of the design of the genetic improvement program or of the genetic gain being achieved. Claims are made by GenoMar, but not substantiated by published information in reputable international journals. GenoMar makes a big issue of its use of DNA technology to ascertain parentage in its GIFT population. An uninformed audience will generally make the inference that a population using such a technology should be of greater genetic merit than one that is not, but that is not necessarily true. It is not uncommon for commercial firms to publicise the use of DNA technology to attract clients, rather than because of the increase in genetic gain they are achieving through the use of such technologies.

There are also issues about trade-off between short term and long term genetic gain. The private sector is much more likely to be concerned about immediate gains than about gains to be realised in some distant future. This could result in neglect of issues such as containment of inbreeding and management of effective population size. Since serving the needs of the poor and small-scale farmers is of little interest to private sector breeding programs, it is essential that public sector breeding programs continue to exist, and to focus on developing strains that will serve them now and well into the future.

### **Lessons Learned from the Creation of GFII and its Alliance with GenoMar**

The GIFT program has undergone transformations and changes that featured various actors and organizations whose roles have evolved over time. The experience in commercialization of products of GIFT research has revealed important lessons, not only to the Philippines, but also to

other developing countries that may be in, or approaching, a similar stage of growth and considering greater private sector involvement in their breeding programs.

One important lesson from the period that followed the completion of the GIFT project is that the management of the nucleus where the genetic improvement program is being implemented requires continued support. It is not realistic to expect economic self-reliance of such a nucleus in immature industries in developing countries. This is exactly what happened with GFII. Because its finances were not in good shape, because not enough money could be made from the sale of brood stock and related services, it was taken over by GenoMar. This meant that the rights to use a strain that had been developed with public funds with the purpose of benefitting small, poor farmers, were transferred to a profit oriented private company. As a consequence, the focus of research, development and target farmers changed. This would not have happened if financial support had been provided to GFII during its early phase of development. WorldFish and the governments of relevant partner countries could have organised such support. Perhaps better use should be made of results that clearly show that from a national viewpoint, investment in genetic improvement programs can be a very attractive proposition (Ponzoni et al. 2007, 2008). In India for instance, the government supports the genetic improvement program with Jayanti rohu. The multiplication phase however is in the hands of the private sector, namely accredited Jayanti rohu hatcheries.

Transfer of the multiplication phase to the private sector does not pose the same kind of difficulty as the transfer of the genetic improvement program itself. In the case of hatcheries the use of an improved strain does not entail radical changes in the management of the enterprise. Furthermore, in hatcheries the turnover of capital is quick and the sale of fingerlings can rapidly compensate for the cost of the brood stock. By contrast, a nucleus where a genetic improvement program is being implemented will have a slow turn over of capital, and will be confronting a culture unaccustomed to relating brood stock price with its genetic merit, the latter being a notion alien to most.

## **WorldFish Work with GIFT and Its Dissemination**

### **Origin of WorldFish GIFT**

As earlier stated, at the end of the GIFT project, GFII was charged with the task of continuing with the genetic improvement program, and partners willing to receive representatives from the GIFT families to continue the work by themselves did so. WorldFish was one such partner, and was assigned the corresponding quota of fish. Note that this distribution of GIFT among partners took place well before the agreement between GFII and GenoMar. Hence, in terms of rights to use the fish, this latter agreement does not include those fish distributed at the end of the project to partners, which in any case, were not signatories to the agreement. GFII was the custodian of WorldFish's GIFT until the move of the center to Malaysia, where it was able to access research facilities to hold the fish through an agreement with the Department of Fisheries,

Malaysia. GFII provided 63 full sib groups of 35 fish each, which were progeny from single pair mated parents (i.e. 63 males each mated to a different female). These fish belonged to the sixth generation of selection of GIFT, and were received at Jitra in batches towards the end of 2000 and at the beginning of 2001. They were mated and produced a 7<sup>th</sup> generation (Base population) in the spawning season of 2002, which in turn produced an 8<sup>th</sup> generation in 2003. No selection took place among the fish transferred from the GIFT Foundation, since they were received in batches and there were uncertainties regarding environmental factors that could have influenced their performance. Two lines were created with the 2002 progeny, one selected on high breeding value for live weight (Selection line), and another one selected for average breeding values (Control line). We have continued the selection work until now producing one generation per year. Numerous publications have been produced, and a sample is listed in Appendix 2.

The WorldFish GIFT population is maintained at the Aquaculture Extension Center, Department of Fisheries, Jitra, Kedah State, Malaysia (latitude 6° N, longitude 100° E, altitude 23 m). The daily average temperature is 27° C, with little variation throughout the year. The annual rainfall is 2057 mm, occurring throughout the whole year but not in a uniform way. Rainfall in December, January and February (the driest months) is one half or less than that during September and October (the wettest months). As a precaution in case a disaster occurs in Jitra, we maintain representatives from all the GIFT families at a different location, namely in the Fish Tank facilities of WorldFish in Penang.

### **Dissemination and Monitoring of the Destiny of WorldFish GIFT to Partner Countries**

Since receiving GIFT in Malaysia from GFII in the Philippines, WorldFish has distributed it to 9 countries. WorldFish considers the GIFT strain an International Public Good, and makes it available to countries that justify its need and that are prepared to sign a Material Transfer Agreement specifying that they will make responsible use of the germplasm they are receiving. The fish are made available at no cost, but in some instances we request a contribution towards the cost of preparation of the fingerlings and their transport to the country in question. We use our own discretion in assessing the country's capability to cover costs. We maintain an inventory of the countries to which GIFT has been sent, of the state of the population, and of its distribution to hatcheries and farmers. In this section we present a summary of the results of the latest collection of information from partners, from a survey conducted in 2009.

#### *Objectives of the survey and maintenance of a GIFT inventory*

The main objectives of this work are to establish a formal inventory of GIFT stock, to strengthen its breeding program, and to implement more effective multiplication and dissemination strategies of this superior fish. This will ensure that the greater productivity of GIFT is maintained and further enhanced, and that the benefits are captured by fish farmers.

### *The problem*

As earlier reviewed, GIFT was developed in the Philippines during the early 1990s and has been distributed to Asian and South American countries. In some cases the strain accounts for a substantial proportion of the total Tilapia production, such as in the Philippines, Bangladesh, Thailand and Vietnam. However, there is no assurance that the benefits initially observed from farming GIFT have been maintained or enhanced over time because a number of important elements are lacking in the strategy so far employed. For instance: (i) until recently there was no formal inventory of the stock that had been distributed, or of the way in which it was being maintained; (ii) there had been no follow up of the genetic improvement program in the countries to which GIFT was sent, and there are presently no planned links with the main nucleus in Malaysia; (iii) the main focus of selection continues to be growth rate, whereas several other traits may also be relevant but are not being selected for; and (iv) with one exception, there is no accreditation scheme rigorously implemented at the hatchery level as a means of quality control of the fingerlings delivered to farmers.

### *Approach and activities*

The approach adopted and the activities conducted are related to the anticipated outcomes. WorldFish files contained some information on number and destination of GIFT over time. This information was used to establish initial contact with the custodians of the stock in the different countries. A set of questionnaires was sent to the custodians to update the information of the GIFT population that was sent (Appendix 3). This contact may be followed up in some instances with a visit to the each country to obtain first hand information regarding the state of the stock, and to formulate appropriate remedying action if necessary.

As a way formalizing the relation between the GIFT nucleus in Malaysia and the populations in other countries we have considered the possibility of establishing a GIFT Breed Association. This notion is currently being discussed in WorldFish. If we proceed along this path, a set of Breed Association Rules would be developed defining the aims of the Association, the eligibility, rights and duties of the members, the functioning and the funding mechanisms for the Association. A genetic improvement program would be designed integrating the GIFT brood stock present in the different countries, thus greatly increasing population size and the scope for further improvement. The program could include traits other than growth rate in the breeding objective, when deemed important, either now or in the future. Responsiveness to treatments for the creation of all male populations for the production system, gutted yield, fillet yield and flesh quality are examples of such traits. The latter three traits would become important if export markets were developed. The existing multiplication and dissemination mechanisms in each country would be examined, and a strategy to improve their effectiveness and impact on farmers would be formulated and implemented.

### *Results*

The WorldFish Center conducted two surveys related to the GIFT inventory. The first survey was carried out in 2005 whereas the second one took place in 2009. GIFT Inventory Forms (Appendix 3) were sent to countries where GIFT stocks were present. The first GIFT inventory survey was sent to 13 different organizations and institutes, but only ten of them responded. They were Bangladesh, Brazil, China, Indonesia, Malaysia, the Philippines (BFAR and GIFT Foundation), Thailand, and Vietnam (RIA1 and RIA2). No responses were received from Fiji, India, and Sri Lanka. Information on GIFT stocks in Malaysia was prepared by the WorldFish Center and the Fisheries Research Institute, Jitra.

For the second GIFT inventory survey, we received responses from 11 organizations and institutes out of 12 survey forms that were distributed. They were Bangladesh (BFRI and BRAC), Brazil, China, Malaysia, the Philippines (GFII and TGA Farm), Sri Lanka, Thailand, and Vietnam (RIA 1 and RIA 2). Table 1 summarizes the multiplication and distribution of WorldFish GIFT by all the custodians of GIFT from the 2009 survey. Note that the figures are as provided by the respondents to the survey and we have no way to verify their accuracy. However, we have evidence that GIFT is in demand in all these countries, it has a good reputation as a productive strain, and the feed back we get from technical staff, hatchery managers and farmers is positive.

Interpreting the results in Table 1 is not easy, but some obvious patterns can be detected. In Bangladesh, China, Philippines, Thailand and Vietnam, WorldFish GIFT has penetrated the countries' tilapia industries, judged both by the number of hatcheries that have received the stock and the number of fingerlings provided to farmers. By contrast, the role of GFII is currently minimum (we are currently examining the possibility of revitalizing GFII, among other things, by sending individuals from WorldFish GIFT in Jitra, Malaysia). Further work with the respondents to our survey would verify the figures and would provide a clearer picture of the distribution of GIFT. In terms of farm enterprise focus the results are variable. For instance, whereas BRAC's focus has been mainly on small and medium farmers, the opposite was true for TGA farm in the Philippines. The consolation is that some fish are filtering through to small farmers, but it is clear that we should try to do better.

**Table 1: Summary of WorldFish GIFT multiplication and distribution by country**

Country (Organization or Institute)	No. of hatcheries that received GIFT	Number of fingerlings sold or provided to farmers	Destiny of GIFT by farm size (percentages)			Percentage of market that are GIFT
			Small	Medium	Large	
Bangladesh (BFRI)	48	150-160 million (monosex)	20	50	30	95 (approx.)
Bangladesh (BRAC)	No information (supplied to own hatcheries)	No information	60	30	10	15 million (approx.; no percentage)
Brazil (Universidade Estadual de Maringa)	54 private; 24 public	78,000 (approx.)	No information			15 (approx.)
China (FFRI)	11	300 million	No information			80
Malaysia (DoF)	36	111,300	Majority			10
Philippines (GIFT Foundation)	None after 2002	None after 2002	Majority			3
Philippines (TGA Farm)	3 (under TGA)	5 million per month	5	15	80	40
Sri Lanka (NAQDA)	No information	No information	No information			90
Thailand (Pathumthani Fisheries Test and Research Center)	292	14,773,947	15	70	15	75
Vietnam (RIA 1)	100	200,000,000	No information			Northern Vietnam – more than 80% Southern Vietnam – less than 30%
Vietnam (RIA 2)	1	500,000	No information			No information

## **Brief Account of the Status of WorldFish GIFT in Each Country**

### *Bangladesh*

GIFT fish in Bangladesh are in the care of Bangladesh Fisheries Research Institute (BFRI, government institute) and BRAC Center (non-government organization).

#### **BFRI**

The GIFT fish were sent to BFRI in 3 stages. The first shipment was sent in July 1994 from the WorldFish Center (formerly known as ICLARM), Manila. This shipment consisted of 1000 fry and was sent for the purpose of comparison between GIFT strain and existing Nile tilapia strain in Bangladesh. The second shipment came from Manila in January 1997 with a total of 400 fingerlings. In 2005, BFRI requested a new batch of fish from the latest generation of GIFT in Malaysia to refresh their breeding program. WorldFish Malaysia sent 750 fingerlings from 30 families in March 2005 to BFRI.

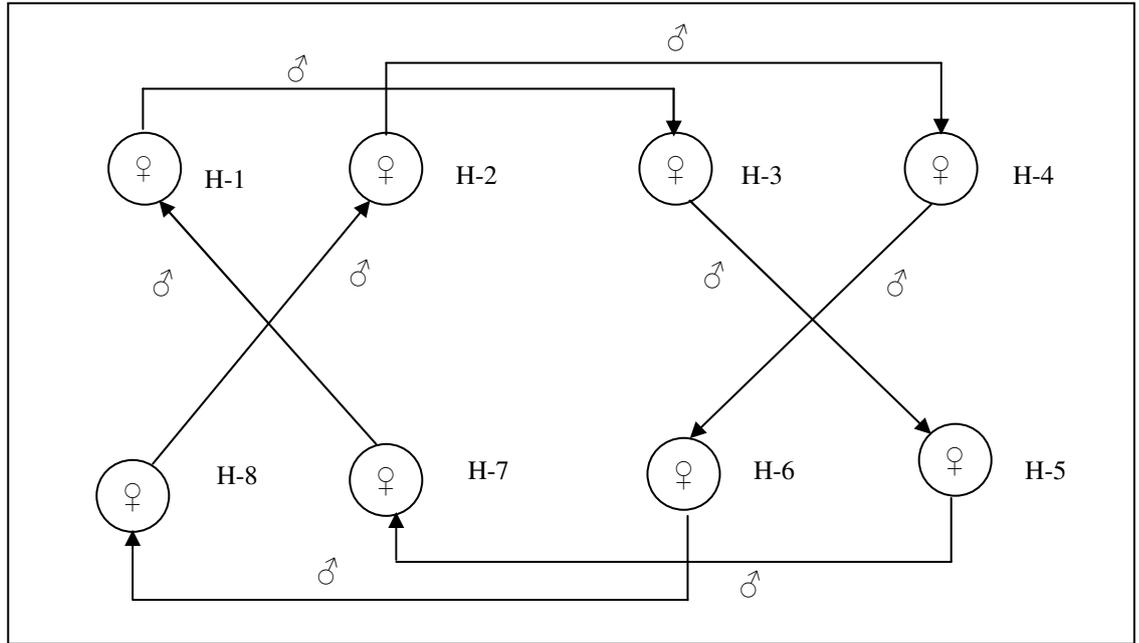
With the second batch of GIFT received from Manila in 1997, BFRI used mass selection strategy for the GIFT fish breeding program. They found that after several generations of selections, inbreeding became apparent in the selected population. Inbreeding problems have also been observed across the country and have led to poor growth performance of GIFT fish. To overcome the inbreeding problem, a new base population was established using the GIFT fish sent in 2005. The breeding program for this stock will follow family selection protocols to avoid inbreeding depression that was experienced with the previous batch. The individuals from the third batch were reared in 100m<sup>2</sup> hapas for three months. They were subsequently tagged with Passive Integrated Transponder (PIT) tags and communally reared in an earthen pond (1000m<sup>2</sup>).

In 2009, 0.5 million GIFT fry were disseminated to 48 tilapia hatcheries across Bangladesh (Table 1). Of these 48 hatcheries and farms, 20% are regarded as small scale, 50% as medium scale and 30% as large scale. GIFT fish have become very popular and well accepted by farmers across the country. Presently, more than 95% of tilapia hatcheries and farms are growing the GIFT strain. Farmers are reportedly happy with the fish that they produce from the GIFT strain. In the meantime, approximately 150-160 million monosex fry have been produced by the hatcheries and sold to farmers.

#### **BRAC**

BRAC head quarters are located in Dhaka and the fish are kept at the BRAC Tilapia Hatchery located at Magura. BRAC is a non-government organization that serves the fish farming community in rural Bangladesh. They received 1290 GIFT fry from eight cohorts (average weight of 8g) from the WorldFish Center, Malaysia in December 2008. They stocked the fry in eight different ponds according to cohort group. In June 2009, BRAC harvested all the fish from these eight ponds to prepare for the

production of the first generation (the average harvest weight was 150g). The breeding scheme practiced by BRAC is cohort mating (Figure 1). Under this breeding scheme, 300 brood stock (75 males and 225 females; ratio of 1:3) from each cohort were involved in the mating. The mating for each cohort was conducted in a 50 m<sup>2</sup> mating hapa. In July 2009, they randomly collected 1200 fry from each mating hapa and stocked them in the ponds, accordingly. BRAC also supplied the surplus fingerlings to the other three BRAC hatcheries to act as satellite nuclei. The only problem they are facing now is the unsatisfactory of reproduction rate during drought season.



**Figure 1: Breeding protocol – Example of rotational mating**

In order to increase the dissemination of GIFT production, BRAC plans to establish new hatcheries at Comilla, Bongra, and Khulna. They hope that by having these additional hatcheries the production will be able to meet the demands from the grow-out farmers.

#### *Brazil*

A total of 600 fingerlings of 30 families (each family consists of 20 individuals) were sent from WorldFish Malaysia to Universidade Estadual de Maringá in March 2005. By September 2009, GIFT in Brazil had been through four generations of selection. The mating ratio applied in their breeding program is one male to two females. All the animals are individually identification using PIT tags. Pedigree analysis using BLUP and animal model was applied to this breeding program.

Non selected individuals are distributed to hatcheries and farmers across the country. So far, the GIFT fish have been supplied to 54 private companies and 24 public institutes or organizations (minimum of 1000 fish per company or organization). These companies or organizations range

from very small to large scale. According to the custodian, they believe that GIFT already has 15% of the market share in Brazil tilapia production. No problems have been encountered to date.

### *China*

#### Shanghai Ocean University

In 1994, Shanghai Ocean University (formerly known as Shanghai Fisheries University) received two batches of GIFT fish from WorldFish Manila. The first batch consisted of 4,000 fish and was sent in July and further 1,000 fish were sent two months later. After one month quarantine the fish were distributed to three National Tilapia Seed Farms at Qingdao, Guangdong and Zhongji.

From 1994 to 1996 a series of evaluations and comparisons were conducted between GIFT tilapia and other existing Nile tilapia strains. The results were all very favorable to GIFT. In the context of this program GIFT fish have been distributed to more than 20 provinces. Unfortunately, Shanghai Ocean University did not respond despite our efforts to the second survey conducted in September 2009. The information reported above is from our first survey conducted in 2005. We were keen to carry out a comparison between the Shanghai Ocean University GIFT and the WorldFish GIFT recently sent to the Freshwater Fisheries Research Center in Wuxi but due to difficulties in communicating with Shanghai Ocean University staff we have been unable to progress this idea.

#### Freshwater Fisheries Research Center

The second GIFT custodian in China is the Freshwater Fisheries Research Center (FFRC) located at Wuxi, Jiangsu Province. FFRC received 1800 pieces of GIFT fingerlings from 60 families (30 fingerlings per family) in August 2006. The population was transferred to the Experimental Farm of FFRC located at Qiting, Yixing for grow-out.

To date (September 2009), this population of GIFT at FFRC has gone through three generations of selection. Pedigree recording is practised (individually tagged with PIT tag), and BLUP animal model is used for data analysis. The mating scheme applied is a ratio of one male to two females. At each generation of selection, a total of 120 families are designed by mating 60 males with 120 females. However, typically, they get only about 100 families per generation. The problem faced by FFRC is that the readiness of female breeders to spawn is low. Some females take more than one month to spawn after mating.

At present, the population serves as a nucleus for this breeding program. The surplus fish from good performing families have been supplied to 11 local hatcheries. According to FFRC estimation, approximately 300 million GIFT fry have been provided to farmers from these hatcheries and 80% of the tilapia fingerlings used by farmers is GIFT.

Staff at FFRC has expressed interest in obtaining the improved Blue tilapia (*Oreochromis aureus*) strain from WorldFish Abbassa in Egypt, to

cross with their GIFT and produce progeny that have high growth rate and high male percentage.

### *Malaysia*

GIFT fish in Malaysia are under the care of the WorldFish Center in collaboration with Department of Fisheries, Malaysia. The fish are maintained at the Aquaculture Extension Center located in Jitra, Kedah State, since the first batch of fish was received at the end of 2000.

The WorldFish Center Malaysia received the GIFT fish from GFII, as mentioned above, in batches towards the end of 2000 and beginning of 2001. By 2009, the WorldFish GIFT population in Malaysia has already gone through eight generations of selection. Each generation 200 breeders (on average) are involved in pair matings in a ratio of one male to two females. During the period 2003 to 2009 the number of sires and dams producing offspring in each generation ranged from 35 to 54 and 65 to 88, respectively. All the fish are individually identified with PIT tag when they reach the tagging size of five to 10 grams. Details on this program can be found in the publications listed in Appendix 2.

The current WorldFish GIFT population in Malaysia fulfils several roles. We have continued and refined the genetic improvement program so that it is continuously achieving genetic gains in harvest weight at a rate of about 10% per year. The fish are being disseminated to government and private hatcheries within Malaysia, and are also the source of GIFT to other partner countries. The Department of Fisheries, Malaysia estimates that 10 per cent of the total tilapia production is GIFT strain. Because we maintain full pedigree records, the data set has become very useful for research purposes, and now consists of more than 20,000 progeny records from more than 350 sires and 550 dams.

To date the GIFT population in Malaysia has not faced any major problems, except through a few natural calamities (storms and floods) that resulted in some losses during the grow-out phase in 2008. In the future, WorldFish intends to further improve the fish by including other economically important traits than growth in the breeding objective. Fish welfare and climate change will also be taken into consideration in our future plans.

### *Philippines*

#### GIFT Foundation International Incorporated

The GIFT population was the product of genetic research in Muñoz Nueva Ecija Philippines since 1988. GFII was supposed to be the custodian of GIFT since 1998 after the GIFT breeding program ended in 31<sup>st</sup> December 1997. According to the person in charge at GFII, since the agreement with GenoMar was signed in 1999 there has been only one spawning for Generation 11. The breeding plan for GIFT was discontinued according to information supplied through the September 2009 survey. Furthermore, in the absence of resources, the breeding nucleus

has undergone no further selection and the GIFT population at GFII is succumbing to old age.

Currently GFII's situation is very precarious. They have provided no brood stock or fingerlings to hatcheries or farmers since 2002. At present WorldFish is discussing revitalizing GFII with Philippine partners.

#### TGA Farms Incorporated

TGA Farms Incorporated is GIFT's second custodian in Philippines. The company is located in Pampanga. During 2006, WorldFish Center Malaysia sent two batches of GIFT to TGA. The first batch was sent in July 2006. Because of the low survival rate during shipping, the number of fish recovered was insufficient to start the program. WorldFish proposed that TGA start their own breeding program with GIFT fry and we sent a second batch of fish in December 2006. The second batch of fish consisted of 3000 fry from 40 families of the latest generation of GIFT at that time.

To date (September 2009), TGA has already produced two generations of GIFT at their farms and they have primarily concentrated on selection for growth rate. The mating scheme practised is a rotational scheme in which they have created eight different cohort groups for every generation with 100 females and 50 males selected from each cohort group. No individual identification is being used.

The current role of the GIFT population under TGA is to produce brood stock for the three hatchery groups of TGA Farms. Thus, commercially produced of fingerlings disseminated to their grow-out farmers in the region where TGA located. The estimated number of fingerlings being disseminated by TGA Farms to grow-out farmers is about four to five million fingerlings per month. Eighty per cent of farmers who purchased GIFT fry from TGA Farms are categorized as large scale, the remainder being small and medium-scale. According to TGA Farms, in the region where they market the fingerlings, about 40% of the farmers are using GIFT for tilapia production.

In August 2007, TGA Farms was hit by a natural calamity. A typhoon caused all the cohort groups to be mixed into one pond through flooding. Following WorldFish recommendations, TGA regrouped all fish recovered after the typhoon and continued with the selection. So far they have not observed any deterioration in quality. Indeed, the situation is quite the opposite, they have received testimonies from farmers saying the fish are performing well and that farm revenues have increased. Nevertheless TGA plans to obtain a new batch of GIFT from WorldFish in the near future to refresh their current population.

#### *Sri Lanka*

The GIFT custodian in Sri Lanka is National Aquaculture Development Authority of Sri Lanka located in Colombo. The fish are kept at their Aquaculture Development Center in Dambulla.

Sri Lanka received their first batch of GIFT in June 2007 with 1250 pieces from 50 different families of the latest generation of GIFT in WorldFish Malaysia at that time. Based on the guidelines provided by WorldFish, the fish were divided into eight groups and reared in eight different cohort ponds. At time of the survey in September 2009, they had already produced two generations of GIFT using the cohort breeding scheme to select for better growth rate. Each generation 5000 fry are selected from each cohort and grown until they reach advanced fingerling stage. The best 200 males and 200 females are then selected based on growth performance (body weight) for conditioning before mating. Ultimately, only the top 40 males and 120 females are selected for the mating.

To date, Sri Lanka has not disseminated GIFT brood stock to other hatcheries. However, during 2008 and the first half of 2009, 4.7 million GIFT fry and 0.55 million GIFT fingerlings were supplied to fish seed producers and fish farmers by Dambulla Aquaculture Development Center. According to Dambulla Center, over 90% of pond fish farmers are growing GIFT fish in their farms. So far, Sri Lanka has not faced any problem with their GIFT breeding program.

#### *Thailand*

GIFT fish in Thailand are in the care of Pathumthani Fisheries Test and Research Center. GIFT were first sent to Thailand in 1994 and 1996 from ICLARM, Manila, as part of the Dissemination and Evaluation of Genetically Improved Tilapia Species in Asia (DEGITA) project, for research purposes. In 2000, Thailand received a batch of GIFT fish from GFIL. A total of 900 fish were received which consisted of 30 families with 30 fish per family. This batch of fish was used for the breeding and dissemination program. Since then three additional batches have been sent by WorldFish in 2004, 2006 and 2007.

From 2001 to 2009, a total of 14.8 million GIFT fish were supplied to 292 hatcheries across the country. During these nine years, Thailand estimated 6,947 million fingerlings have been sold to farmers by these hatcheries. The main recipients of the fish are medium scale farmers (70%). Small and large scale farmers have an equal share of 15%. It is estimated that 75% of the total number of tilapia fingerlings grown out by farmers is GIFT. Cohort mating will remain in use for their GIFT breeding program.

#### *Vietnam*

GIFT fish in Vietnam are in the care of Research Institute for Aquaculture No.1 (RIA1) and Research Institute for Aquaculture No.2 (RIA2).

##### Research Institute for Aquaculture No.1

GIFT was first sent to RIA1, Vietnam, in 1997 from GFIL. The shipment consisted of 20,000 fingerlings from 106 families of the 5<sup>th</sup> generation in Philippines. In setting up the base population, 80% genetic material of GIFT and 20% of Thai tilapia were used. The population was selected for

growth rate (body weight and length) based on a combined family and individual selection method. The mating ratio was one male to two females. All fish were identified with PIT tags.

So far eight generations of improved tilapia have been produced with 80 to 140 families in each generation. The improved fish is known as NOVIT tilapia and it is claimed that it is 52% superior in term of growth, compared to the base population. The original GIFT fish no longer exist in RIA1 since they are only maintaining their new strain (NOVIT) in which GIFT and Thailand tilapia have been combined.

At present RIA1 is supplying their NOVIT fry to almost 100 hatcheries (provincial, private and government). They also supply brood stock to departments and centers under RIA1 to maintain their own populations and to produce fingerlings for selling to farmers. The estimated number of fingerlings sold or provided to farmers is about 200 million. In addition, one center under RIA1, located in central Vietnam (Quang Nam Province), is cooperating with international organizations to identify potential markets for brood stock overseas, including Brazil, Mexico and Uganda. Because the original GIFT fish are no longer maintained by RIA1, they believe that out of the total tilapia production in Vietnam, the original GIFT currently has a market share of less than 30 per cent.

RIA1 has received some complaints from farmers and researchers, claiming that the NOVIT tilapia is smaller and has poorer growth rate than the GIFT that was first introduced in 1997. The deterioration of quality or growth rate in NOVIT may be caused by inbreeding depression and poor management over time. This is very surprising as the number of families was maintained at ca 100 for many years. An explanation is that it could be due to selection for both harvest weight and cold tolerance for several generations as a part of the Genetic component of the NORAD projects (1999-2006).

In future, RIA 1 would like to obtain a new batch of GIFT from WorldFish to conduct a strain comparison between NOVIT tilapia and GIFT. At the same time, they will also carry out on-farm assessment of their NOVIT strain. Introducing a new source of genetic materials to their NOVIT population is also part of their future plan.

#### Research Institute for Aquaculture No. 2

RIA2 is the second GIFT custodian in Vietnam. The research institute is located at Ho Chi Minh City and GIFT is kept at their breeding center in Cai Be, Tien Giang Province.

In June 2006, WorldFish sent the first batch of GIFT to RIA2. This batch of fish consisted of 1,200 fingerlings from 50 families of the latest generation of GIFT at that time. At RIA2, they used two different types of mating scheme for their GIFT breeding program, pair mating and mass spawning. For the pair mating population, they have already been subjected to two generations of selection and a third generation will be produced in 2010. In each generation, they produce about 100 families for this pair mating population and PIT tags are used to identify the fish.

On the other hand, the mass spawning population consists of four cohorts in a rotational mating scheme such as that described in Figure 1. Every spawning season, each cohort will have 12 males and 24 females represented in the mating. The two mating schemes are part of a research study undertaken by a post-graduate student.

So far only one hatchery has been supplied with GIFT for production. However, RIA2 estimates that the number of fingerlings sold or provided to farmers from this hatchery and RIA2 hatcheries is about 500,000.

### **WorldFish and the Dissemination of GIFT to Africa**

Because Africa is the world's repository of a diverse freshwater fish fauna and home to native tilapias, conservationists and environmentalists are especially concerned over what might be the possible consequence of the large-scale commercial dissemination of improved strains to this region. Until 2007 WorldFish's policy was not to send GIFT to African countries, but encourage the development of improved strains from local varieties. The logic behind this thinking was that locally developed improved strains would differ less from the native tilapia, and hence pose less of a threat. However, if the selection program is effective, the improved strain, though developed from local populations, will become different from the wild counterparts, posing as much of a threat as GIFT. Furthermore, there is evidence that the private sector has been involved in introductions of GIFT to African countries, with few or no regulatory constraints. Given this scenario WorldFish concluded that it would be better to have a policy of admitting GIFT into Africa, but imposing conditions that if adhered to by the host country would minimize risks. The policy document developed by WorldFish is reproduced in Appendix 4. To date, there have been many applications, but no introductions of GIFT to Africa by WorldFish.

### **Concluding Remarks**

There is no doubt that the GIFT project has had an impact world-wide. Both the technology and the genetically improved fish have been widely distributed and are now known. Whereas we believe that it is fair to say that in many instances the improved fish have reached and benefitted the poor, it is also an area where gross mistakes were made. Such mistakes separated events from a path that could have benefitted the poor much more. The first miscalculation was to assume that GFII was going to rapidly become financially self-reliant and that it did not require further support. This mistake led to another, even greater error of judgement, the alliance between GFII and GenoMar, whereby the latter profit oriented company obtained the right to breed and market GIFT. This decision brought about a change of focus of GFII from breeding and dissemination of GIFT fish to poor and small scale farmers to meeting the business objectives of GenoMar instead.

Fortunately, WorldFish received a sample of 63 GIFT families at the end of the project, and continued with the genetic improvement program. WorldFish refined the program in several ways, and continues to do so.

In a recent paper (Ponzoni et al. 2010) the state of the population is thoroughly examined and a future course of action to further develop the strain is plotted. In simple terms, the intention is to ‘link’ GIFT populations in different countries so that the effective population size is greater than in any individual population. If this were formalized in an arrangement similar to those prevalent in breed associations of terrestrial animal species, it would go some way towards ‘protecting’ the strain from genetic piracy. The statement by Eknath and Hulata (2009, p. 209) that reads ‘Without the assistance of GenoMar the ‘GIFT legacy’ would have most certainly been lost forever.’ is unjustified and very far removed from the truth. WorldFish has continued working with GIFT in a manner totally consistent with the spirit of the original project and is determined to continue using both the technology and the strain to help the poor. The demand for the strain and the satisfaction expressed by those that receive it from WorldFish attest to its genetic merit. The well thought through (and frequently positive) responses to all requests for the strain are indicative of WorldFish’s commitment to its objective of helping poor farmers, in this instance through the distribution of this unique International Public Good.

## **Acknowledgements**

We thank Dr Malcolm Beveridge for reviewing and editing the manuscript. His input substantially improved the clarity of the text in many sections. However, the authors take responsibility for the contents of the report.



## Appendix 1

### AMENDED AND RESTATED MEMORANDUM OF AGREEMENT

This **Memorandum of Agreement** (the "Agreement") is being entered into this 15<sup>th</sup> day of April, 1999 by and between:

**THE GIFT FOUNDATION INTERNATIONAL, INC.** (hereinafter referred to as "the Foundation"), a non-stock non-profit corporation established under the laws of the Republic of the Philippines, with principal offices located at the Center for Applied Fish Breeding and Genetics Research, Central Luzon State University Campus, Muñoz, Nueva Ecija, Philippines, and represented in this Agreement by its Executive Director, Mr. Basilio M. Rodriguez, Jr.,

- and -

**BIOSOFT AS** (hereinafter referred to as "BioSoft"), a corporation established under the laws of Norway, with principal offices located at the Oslo Research Park, Gaustadalleen 21 Oslo, Norway, and represented by this Agreement by its Founder and Chief Executive Officer, Prof. Øystein Lie.

Witnesseth: That

#### WHEREAS:

- A. The Foundation was established with the primary objective of conducting selective breeding research on Nile Tilapia and for the further development and dissemination of the "GIFT Strain", a genetically improved strain of Nile Tilapia, through a network of Tilapia hatcheries and grow-out farmers in the Philippines.
- B. The Foundation, as a result of agreements made by and between the primary project partners before the expiry of the GIFT Project and as a result of additional breeding work it has conducted using its own resources, has in its possession and ownership, improved Nile tilapia broodstock, and has registered a copyright with the National Library of the Philippines for the "GIFT Super Tilapia with logo" under Certificate of Copyright Registration No. M-98-086 dated 20 February 1998 as well as filed an application for registration of the trademark "GIFT Super Tilapia and logo" with the Intellectual Property Office of the Philippines as Application No. 4-1998-00583.
- C. The Foundation's primary purpose has been to continue the selective breeding activities started under the GIFT Project with revenues generated from the commercial distribution of GIFT tilapias. The Foundation, since its formal establishment has developed a network of hatcheries and grow-out farmers for the multiplication and efficient distribution of the GIFT strain in the Philippines.
- D. BioSoft was established in June 1996 as a company to work towards the safe food supply and sustainable management of renewable aquatic resources worldwide. BioSoft has established core competencies in the development and implementation of genomic tools in selective breeding for various economically important traits, fish health management and diagnostics and quality assurance; and a network of partnerships with leading research institutions and commercial fish breeding operations worldwide.

- E. The Foundation and BioSoft recognize that combining their respective core competencies should result in a state of the art fish breeding enterprise with primary focus on an internationally traded whitefish commodity, the Nile Tilapia.
- F. The Foundation and BioSoft recognize that such a breeding enterprise has the potential to contribute significantly to increasing supplies of more affordable fish.
- G. The Foundation and BioSoft have expressed a desire to work together on fish breeding research encompassing state of the art selective breeding tools and genomics and on the further commercialization of the GIFT strain in the Philippines and elsewhere.
- H. The Foundation and BioSoft have agreed that the most effective way of achieving this is through an in-kind contribution by the Foundation in the equity of BioSoft which will then serve, under the terms and conditions of this Agreement, as the vehicle for commercialization of opportunities arising from the research conducted by both parties.

**NOW THEREFORE**, the Parties agree as follows:

## **ARTICLE ONE. DEFINITIONS AND INTERPRETATION**

### **1.1. Definitions.**

For the purposes of this Agreement, unless the context otherwise requires, the following terms shall have the following meanings:

“**Agreement**” means the whole of this document including its Recitals and Schedules, and any amendments hereto signed by the Parties.

“**Assets**” has the meaning set out in Article 2.2.

“**BioSoft**” includes its successors and assigns.

“**Collaborative/Contracted Research**” has the meaning set out in Article 3.1.

“**Commercial Rights**” has the meaning set out in Article 3.3 and 3.5.

“**Foundation**” includes its successors and assigns.

“**GIFT Strain**” means the results of the “Genetic Improvement of Farmed Tilapia” Project undertaken as a collaborative research and training initiative among the International Center for Living Aquatic Resources Management, the Philippine Bureau of Fisheries and Aquatic Resources, the Freshwater Aquaculture Center of the Central Luzon State University, and the Institute of Aquaculture Research, Ltd. (AKVAFORSK), under the auspices of the Genetic Improvement of Farmed Tilapias (GIFT) Project funded by the United Nations Development Programme (UNDP) and the Asian Development Bank and the organizations involved and supported through the supply of fish from Egypt, Ghana, Kenya and Senegal,

“**Independent Research**” has the meaning set out in Articles 3.1 and 3.4.

“**Nile Tilapia**” means the variety of fish with the scientific name of *Oreochromis niloticus* which is the subject of the research, breeding, development and production activities of the Foundation and BioSoft.

“**Party/Parties**” means BioSoft and the Foundation and their respective successors and assigns.

“**Right to Buy Back Assets**” has the meaning set out in Article 2.3.

“**Shares**” has the meaning set out in Article 2.5(a)

## **1.2. Interpretation.**

In the interpretation of this Agreement, unless the context otherwise requires, the singular shall include the plural and vice versa and any word or expression defined in the singular shall have the corresponding meaning if used in the plural and vice versa and a reference to any gender shall include the other gender.

## **1.3. Reference to Currency**

Reference in this Agreement to currency are references to the United States currency (US\$) and where appropriate, to the Philippine currency, Peso (P) or Norwegian kroner (NOK).

## **1.4. Incorporation of Schedules**

Each Schedule to this Agreement is hereby incorporated into this Agreement.

## **1.5. References to Article and Articles**

A reference to an Article or Articles in this Agreement, unless the context otherwise requires, shall be a reference to the relevant Article or Articles of this Agreement.

## **1.6. Table of Contents and Headings**

The table of contents and headings to this Agreement are for ease of reference only and shall not in any way affect the construction of this Agreement.

# **ARTICLE TWO. INVESTMENT BY THE FOUNDATION IN BIOSOFT**

## **2.1 Agreement for the Foundation’s Investment in BioSoft**

The Foundation and BioSoft agree to jointly undertake the commercial development of the international market for genetically improved Nile Tilapia. To achieve this joint venture, the Parties agree that the most effective and expedient manner to working together is through an equity participation by the Foundation in BioSoft in the form of an assignment of certain assets of the Foundation in exchange for a certain number of shares in BioSoft under the terms and conditions hereinafter provided. The Parties agree that BioSoft shall be the vehicle for the commercialization of outputs of research jointly conducted by the Parties. BioSoft, being the commercial vehicle for research conducted by both parties, will, through the investment of the Foundation, and as one of its major business objectives, position itself to become the world's leading supplier of genetically improved tilapia broodstock leading to better yields and incomes for fish farmers as well as larger supplies of fish at affordable prices for the consuming public.

## **2.2 Assignment of the Foundation’s Assets to BioSoft**

In consideration for the issuance by BioSoft to the Foundation of the Shares as provided in Article 2.5(a) of the Agreement, the Foundation does hereby assign, transfer and convey to BioSoft the following assets (the “Assets”), as specified in Schedule A annexed to this Amendment Agreement:

- i. Replicates of the latest generation, also known as “G10”, developed and bred by the Foundation from fish from the GIFT Project’s sixth generation selection experiments, also known as “G9”, and parent breeders from the Foundation’s Pilot Hatchery, for BioSoft’s exclusive and unrestricted commercial use, as well as a copy of the database on GIFT licensed hatcheries;
- ii. Access to the associated Nile Tilapia genebanks, both live and cryopreserved, and background information on these genetic materials; and
- iii. Exclusive commercial rights to use the “GIFT Super Tilapia” trademark in the Philippines.

The Assets shall be delivered by the Foundation to BioSoft as soon as possible after the signing of this Agreement and related documents and prior to the issuance of the Shares as required by Norwegian law in case of issuance of new share capital in accordance with the form for the Deed of Assignment prescribed in Schedule B hereof. Transfers by BioSoft of any of these assets outside the Philippines will require compliance with Philippine laws, if any, regulating the transfer of such materials.

### **2.3 Foundation’s Right to Buy Back Assets**

Should BioSoft within a period of twelve (12) months from the execution of this Agreement decide to sell its Nile Tilapia breeding business based on the GIFT brood stock, BioSoft shall grant the Foundation the Right to Buy Back the Assets at the market price of the business. The Foundation’s Right to Buy Back may be exercised within a period of thirty (30) days from receipt of an offer from BioSoft by notifying BioSoft of its acceptance. If the Foundation does not exercise its Right to Buy Back the Assets on the terms offered by BioSoft, BioSoft may only sell its Nile Tilapia breeding business to third parties upon conditions not more favourable than that offered to the Foundation, i.e. current market price.

### **2.4 BioSoft's Capitalization**

BioSoft has an authorized capital stock of Norwegian kroner (NOK) 1,734,200 divided into 17,342 shares of stock with a par value of NOK 100 each share and a subscription price per share based on the most recent private placement in the amount of NOK 8,500.

### **2.5 Issuance of Shares to the Foundation by BioSoft**

#### *(a) Issuance of 1,000 Shares:*

In consideration of the assignment and conveyance by the Foundation of the Asset, BioSoft shall, in accordance with the procedure described in Schedule C annexed to this Agreement, issue to the Foundation without unnecessary delay upon delivery of the Asset One Thousand (1,000) fully paid and non-assessable shares of stock in BioSoft (the “Shares”) with a total par value of NOK 100,000 and a total value of NOK 8,500,000 – Eight Million Five Hundred Thousand Norwegian Kroner – at a share subscription price of NOK 8,500 each share.

In the event that BioSoft is unable to issue the Shares in accordance with Schedule C, the assignment of the Assets referred to in Article 2.2 shall be of no force and effect and considered as rescinded.

#### *(b) Additional and Future Issuance:*

BioSoft confirms that under Norwegian law, the Foundation, as a shareholder of BioSoft, has a statutory preemptive right to participate in any additional and future issuance of shares in proportion to its equity ownership in BioSoft at the time of such new issue subject to such shareholders’ rights as may be provided for by Norwegian law.

(c) Legal Opinion:

BioSoft commits itself to secure favorable opinion from its legal counsel that the issuance of the Shares to the Foundation in exchange for the Foundation's Assets herein agreed upon are valid and enforceable and shall be free and clear of all liens and encumbrance.

## **2.6 Representation of the Foundation on BioSoft's Scientific Advisory Board**

BioSoft agrees to provide a seat on BioSoft's Scientific Advisory Board to a nominee of the Foundation. Such Foundation nominee shall enjoy the same privileges, benefits, terms and other rights as those enjoyed by existing members of BioSoft's Scientific Advisory Board.

## **ARTICLE THREE. RESEARCH COLLABORATION AND COMMERCIAL RIGHTS**

### **3.1 Agreement on Collaborative/Contracted Research and the Foundation's Independent Research**

From its inception and through its organization, the Foundation has been viewed as a novel way to raise funds for research through the commercialization of research outputs. The commercialization of research outputs requires the Foundation to enter into alliances, partnerships, agreements and contracts with private sector entities with the capacity to effectively and efficiently pursue commercial opportunities.

The Parties agree to make BioSoft the commercial vehicle for research conducted by both Parties while at the same time allowing the Foundation to continue its stated primary objective of conducting Nile Tilapia selective breeding research. The Foundation may choose to conduct research activities either on its own or in collaboration with public and/or educational institutions with funding provided by the Foundation from its own resources or grants from third parties ("Independent Research").

BioSoft agrees to serve as a key research partner of the Foundation and is prepared to contribute funds to research projects conducted by the Foundation either in collaboration with or under contract with BioSoft ("Collaborative/Contracted Research") to further develop the Foundation's staff and procedures. The Foundation agrees to consider BioSoft as a prime research and development partner.

### **3.2 Term and Coverage of Collaborative/Contracted Research**

For a minimum period of five (5) years from signing of this Agreement, BioSoft shall provide the Foundation with grants or payments for Collaborative or Contracted research amounting to not less than NOK 700,000 – seven hundred thousand Norwegian kroner – per year to cover basic operating expenses and the technical staff necessary for the execution of the Collaborative or Contracted Research. This minimum committed amount will not cover additional project specific expenses such as purchases of equipment, leases on land and/or facilities, building and other leasehold improvements, technical or scientific staff employed by BioSoft, international consultants and international travel which shall all be borne by BioSoft. BioSoft shall, however, consider additional funding and material support for the upgrade and maintenance of research facilities, laboratories equipment and supplies if the same are necessary for the successful completion of the Collaborative or Contracted Research previously funded and upon presentation by the Foundation of the necessary budget and audited accounts.

The grants or payments to be provided by BioSoft shall be given only on the condition that (i) these be directly related to specified projects with corresponding budgets and audited accounts

(See Articles 3.8 and 3.9); and (ii) that the function and mission of the Foundation as a non-stock, non-profit organization remain unchanged.

### **3.3 Commercial Rights to Outputs of Collaborative/Contracted Research**

For the same period of five (5) years, BioSoft shall have the exclusive right to all commercial applications arising from such Collaborative/Contracted Research, without any additional compensation to the Foundation.

### **3.4 Independent Research by the Foundation**

Funding for the Independent Research activities will be obtained by the Foundation from its own resources or from grants obtained specifically for these research activities. The Foundation will be required to disclose to BioSoft on an annual basis, Independent Research activities undertaken by the Foundation, collaborating partners, if any, and expected/actual research outputs generated provided that BioSoft shall not without the prior written consent of the Foundation disclose such information to any third party (See Article 3.11).

### **3.5 Commercial Rights to Outputs of the Foundation's Independent Research**

Prior to undertaking any independent research activity during the first ten (10) years of this Agreement, the Foundation will invite BioSoft, its prime commercial research partner in fish genetics and germplasm enhancement, to participate in the proposed research activity as follows:

- i. If BioSoft declares an interest in participating in the proposed research activity, the Foundation, BioSoft and other parties, if any, interested in participating in the proposed research activity will negotiate among themselves the terms of participation in the activity as well as the manner in which commercial applications, if any, resulting from this research activity will be handled.
- ii. If BioSoft, for any reason, declines to participate in the proposed research activity, the Foundation will be free to undertake the research activity, by itself or in collaboration with third parties. Rights to commercial applications, if any, arising from this research activity will then belong to the Foundation unless agreements entered into with collaborating and/or funding third parties prior to the research activity require the Foundation to share such commercial rights with third parties.

### **3.6 Access to the Foundation's staff, resources and facilities for Collaborative/ Contracted Research**

- (a) For the duration of this arrangement, the Parties shall provide each other with periodic written reports of research and development activities pursuant to these Collaborative/ Contracted Research arrangements. During the term of the Collaborative/Contracted Research arrangement, the Foundation shall keep complete and accurate books and records to permit proper determination of the accuracy and correctness of the research procedure applied by the Foundation. The Foundation shall make such records available to BioSoft or its authorized representative(s) at any time during reasonable business hours.
- (b) The Foundation shall ensure that it shall, at all times, have the necessary number of qualified research personnel who shall provide the scientific and technical knowledge needed to conduct and complete the research requirements.

### **3.7 BioSoft's Obligation to Fund Collaborative/Contracted Research**

During the term of this arrangement, BioSoft shall ensure that it shall have sufficient funding for the Collaborative and Contracted Research it contracts or undertakes in collaboration with the Foundation. BioSoft shall ensure that agreed upon funds release schedules are met provided, that in each particular Collaborative and Contracted Research, the obligations of the Foundation are specifically laid out and met according to agreed upon schedules.

### **3.8 Budgets and Books of Account for Collaborative/Contracted Research**

The Foundation shall prepare on a timely basis comprehensive budget proposals as well as schedules for necessary funding releases for each Collaborative/Contracted Research project with BioSoft.

Towards this end, the Foundation shall maintain books of accounts for all funding provided by BioSoft, separate and independent of all other funding it receives or revenues it generates on its Independent Research.

The Foundation shall on a quarterly basis prepare and submit a report to BioSoft summarizing the use of the funds released to the Foundation by BioSoft.

### **3.9 Other Obligations in Collaborative/Contracted Research:**

- (a) During the term of the Collaborative / Contracted Research, the Foundation shall comply with all activities and commitments included in workplans mutually agreed upon by both Parties. Such activities and commitments may include any or all of the following acts:
  - i. Collect, organize and analyze the necessary data for the Collaborative/Contracted Research activities with BioSoft.
  - ii. Interpret and present the results, reflecting the sample size and test methods, and aid BioSoft in formulating a decision to proceed with, or refrain from, the introduction of new tilapia breeds or other products.
  - iii. Determine the quantitative and qualitative significance of the data collected, establish tentative conclusions by direct and related studies, test the feasibility, viability, and accuracy of the tentative conclusions by reviewing all data and alternative strains/breeds, and establish final conclusions based on interpretations of all the above considerations.
  - iv. Be responsible for a determination of the method of presentation of the study results, for the preparation and accuracy of the reports, and for the presentation of the reports, which shall be done in conjunction with an oral presentation of the interpretation of the results of the study.
  - v. Conduct all other research tasks that may be required by BioSoft.
- (b) During the term of the Collaborative/Contracted Research, both Parties shall release and make available to each other all information required to implement any Collaborative/Contracted Research Project agreed upon by the Parties.

### **3.10 Proprietary Rights on Research Outputs from Collaborative/ Contracted Research:**

Except as otherwise agreed upon by the Parties, BioSoft shall retain all proprietary rights (of any nature whatsoever throughout the world) in and to all BioSoft products (and all equipment and components therein) and to all discoveries, inventions, patent rights, trade secrets, know-how or other data arising out of work of BioSoft and the Foundation in the Collaborative/Contracted Research, provided, that in the publication of any discoveries, inventions and other novel information resulting from these Collaborative/Contracted Research activities, proper attribution to the valuable contribution and indispensable role of the Foundation shall be made.

### 3.11 Confidentiality

The Parties agree on the following:

- (a) Information disclosed by either Party will be received and held in confidence by the receiving Party and will not be disclosed to any third parties unless it has been authorized for release in writing by the disclosing Party. This obligation will not apply to information which, as can be shown by the receiving party, was known to the receiving party prior to the disclosure thereof or, through no fault of the receiving Party, is or becomes generally available to the public or is disclosed to the receiving Party by third parties which are under no direct or indirect secrecy or confidential obligation to the disclosing party, or is developed independently from information by the receiving party.
- (b) The receiving party will disclose information only to those members of its personnel who need to have access to the information due to their involvement in the evaluation of possibilities of cooperation and the receiving party will ensure that said members of its personnel are also committed to the secrecy obligations.
- (c) The receiving Party will only disclose information to affiliated companies in case the affiliated company is obliged to the same degree of confidentiality as is the receiving party and such disclosure in advance is announced in writing to the other Party.

### 3.12 Termination of Collaborative/Contracted Research

- (a) The agreement of the Parties in respect of Collaborative/Contracted Research may be terminated at any time by mutual consent of the Parties, such agreement to be evidenced in writing and signed by both Parties.
- (b) The agreement on Collaborative/Contracted Research may be terminated prior to its expiration by the appropriate party, as hereinafter specified, not less than thirty (30) days after the written notice, if any of the following events shall have occurred and be continuing for a period of ten (10) days:
  - i. By BioSoft, if the Foundation makes any arrangement with its creditors generally, has a receiver or administrator appointed, or execution levied upon, all or part of its business assets, goes into liquidation (otherwise than for purposes of merger or consolidation) or dissolution under any bankruptcy, reorganization, insolvency or similar laws or becomes unable to pay its debts when due; or if the Foundation sells or disposes of all or a substantial part of its business or assets; or if there is a substantial change in the Foundation's purposes, business or conduct thereof. The Foundation shall promptly and fully inform BioSoft of the imminence or occurrence of any event described herein.
  - ii. By the Foundation, in the event that BioSoft shall have a receiver or administrator appointed or execution levied upon all or any part of its business or assets, goes into liquidation (other than for the purpose of merger or consolidation) or dissolution under any bankruptcy, insolvency or similar laws, or if BioSoft is unable to fulfill its obligations under the agreement. BioSoft shall promptly and fully inform the Foundation of the imminence or occurrence of any event described herein.
  - iii. By BioSoft, if the Foundation spends the funds released by BioSoft on a particular Collaborative/Contracted Research to purposes other than that mutually agreed upon by them without notice to and approval of BioSoft and the Foundation is unable to reimburse the particular Collaborative/Contracted Research within a period of fifteen (15) days from demand by BioSoft.
  - iv. By the Foundation, if BioSoft fails to provide the funding requirements for the Collaborative/Contracted Research within a period of fifteen (15) days from the date agreed upon by the Parties as stated in the proposal of the Foundation or instructions of BioSoft.

- v. By either party, if the other party fails to observe or perform and/or breaches any term or condition of the agreement on Collaborative/Contracted Research to be observed or performed by it, following thirty days written notice of default fully describing the breach and the acts believed necessary to remedy the same and the recipient failing to remedy the default or breach within the said thirty day period.

#### **ARTICLE FOUR. AGREEMENT ON PATENTS AND OTHER INTELLECTUAL PROPERTY RIGHTS**

##### **4.1 BioSoft will establish procedures to differentiate and protect the breeds it will be subsequently developing from the replicates and seek to have its own patent over said new breeds.**

The parties agree that either of them may undertake any patenting activities and other actions to protect intellectual property rights, provided that fish breeds and other inventions being patented satisfy legal requirements for being distinct from other breeds. Such patenting activities and protection of intellectual property rights shall be guided by the following principles:

- i. The Foundation shall have the right to patent or obtain any other form of intellectual property protection on breeds they have been able to develop from the GIFT Project germplasm materials and other germplasm materials, other than the Assets, it is holding as of the date of the signing of the Agreement and said patents shall not form part of the Assets transferred under the Agreement.
- ii. The Foundation shall also have the right to patent or obtain any other form of intellectual property protection on any new generations or breeds it may develop from germplasm materials, other than the Assets, they hold as of the date of the signing of the Agreement, provided that such development will have been undertaken independently from BioSoft.
- iii. BioSoft shall have the right to patent or obtain any other form of intellectual property protection on new generations and breeds that BioSoft develops from the Assets.
- iv. The Foundation agrees not to file patents or obtain any other form of intellectual property protection that could restrict BioSoft's use of the Assets and as such could be in conflict with the intentions and rights laid down in the Agreement, patent rights included, and shall see to it that this information is also contained in any filed patent.
- v. BioSoft agrees not to file patents or obtain any other form of intellectual property protection that could restrict use by the Foundation or any other party of earlier generations of the GIFT strain that had been distributed prior to the signing of the Agreement.

#### **ARTICLE FIVE. AGREEMENT ON DISTRIBUTION OF NILE TILAPIA BREEDS**

##### **5.1 BioSoft agrees for the Foundation to maintain all of its existing commercial distribution contracts with GIFT Licensed Hatcheries and other parties based on its own broodstock, as shown in Schedule D hereof, and to retain the revenues generated from these contracts until these contracts expire or are voluntarily preterminated by these GIFT Licensed Hatcheries in favour of alternative arrangements that BioSoft may eventually offer them for the production and distribution of fingerlings from the breeds to be developed and introduced by BioSoft.**

- 5.2** The Foundation agrees, as of the date of this Agreement,
- (a) not to enter into new licensing contracts with new hatcheries, expand the production capacities of existing GIFT Licensed Hatcheries beyond what have been already committed or extend the terms, as given in Schedule D, or object to the voluntary pretermination of existing contracts by GIFT Licensed Hatcheries in favour of alternative arrangements to be offered by BioSoft, and
  - (b) that there will be no transfers out of the Foundation of germplasm owned by the Foundation (See Section B of Background Information to Schedule A) for commercial purposes, except to BioSoft, unless such transfers are made under contractual commitments as set out in Schedule D. Institutions to which germplasm will be transferred for research purposes will be notified of this restriction and will be required to acknowledge such restrictions in the research agreements it enters into with the Foundation.
- 5.3** The Parties agree that as an integral part of this Agreement entered into by them, they shall execute without unnecessary delay, a separate agreement on the appointment of the Foundation as a partner to BioSoft in establishing and running the Nile Tilapia commercial breeding operation developed from the Collaborative/Contracted Research, the terms and conditions of which appointment shall be defined in the Distribution Agreement.

## **ARTICLE SIX. CONDITION PRECEDENT TO RIGHTS AND OBLIGATIONS**

### **6.1. Due Diligence Examination by the Parties**

This Agreement is subject to the condition precedent that both the Parties are fully satisfied with the results of a due diligence examination which either of them, at its sole discretion, may perform by itself or through its duly appointed representatives within a period of forty-five (45) days from signing of this Agreement. Either Party may, within a period of fifteen (15) days from signing of this Agreement, elect not to proceed with the conduct of a due diligence examination by notifying the other Party of such decision, in which case, this Agreement shall in respect of such Party become in full force and effect thereby binding such Party to the terms and conditions of the Agreement.

## **ARTICLE SEVEN. REPRESENTATIONS, WARRANTIES AND COVENANTS**

### **7.1 The Foundation's Representations and Warranties**

The Foundation represents and warrants to BioSoft that:

- (a) it is a corporation organized and existing under the laws of the Philippines;
- (b) it has full power and lawful authority to execute and deliver this Agreement and to observe and perform all of its respective obligations in and under this Agreement;
- (c) its execution, delivery and performance of this Agreement do not violate, with or without the giving of notice or the passage of time, any provision of law now applicable to it and do not conflict with, or result in a breach of any provision of any license, franchise, indenture, deed of trust, research grant, undertaking or other obligation to which it is a party, or by which it may be bound;
- (d) it has absolute right, title and interest in and to the Assets to be transferred to BioSoft (See Article 2.2 and Schedule A).

## 7.2 BioSoft's Representations and Warranties

BioSoft represents and warrants to the Foundation that:

- (a) it is a corporation organized and existing under the laws of Norway;
- (b) it has full power and lawful authority to execute and deliver this Agreement and to observe and perform all of its respective obligations in and under this Agreement;
- (c) its execution, delivery and performance of this Agreement do not violate, with or without the giving of notice or the passage of time, any provision of law now applicable to it and do not conflict with, or result in a breach of any provision of any license, franchise, indenture, deed of trust, or any other agreement; and
- (d) it has the resources, capital and technical expertise to perform its undertakings, and that it can issue the Shares, and operate as a commercial vehicle for this venture under the provisions of the laws of Norway.

## 7.3 Mutual Covenants

The Parties covenant and agree with each other as and from the signing of this Agreement that it will:

- (a) observe and perform its obligations under this Agreement and generally conduct itself in the furtherance of the object set forth in Articles 2.1 and 3.1 in the spirit of this Agreement;
- (b) be just and faithful to each other in and about all activities and dealings in relation to this Agreement;
- (c) bind themselves to strictly adhere to the provisions of the relevant Philippine and Norwegian laws.

## ARTICLE EIGHT. NOTICES

### 8.1 Addresses

Any notice, consent or other communication required or permitted by this Agreement shall be in writing addressed to the Parties at the following addresses, or to such other address as a Party shall have specified in writing:

Foundation:      GIFT FOUNDATION INTERNATIONAL, INC.  
                          Center for Applied Fish Breeding and Genetic Research  
                          Central Luzon State University Complex, Muñoz, Nueva Ecija, Philippines  
                          Telephone:      +63-44-456 0673  
                          Facsimile:      +63-02-809 9454

BioSoft: **BIOSOFT AS**  
                          Oslo Research Park  
                          Gaustadalleen 21  
                          Oslo, Norway  
                          Telephone:      +47-22-958 700  
                          Facsimile:      +47-22-565 390

### 8.2 Deemed Notice Provisions

A notice, consent or other communication shall be effective:

- (a) if delivered personally, on delivery;

- (b) if mailed to an address, in the city of dispatch, on the expiry of 3 days after the day of dispatch;
- (c) if mailed from outside Norway or from outside the Philippines, on the expiry of 14 days after the day of dispatch; and
- (d) if sent by facsimile, on the expiry of 24 hours from the time of transmission.

## **ARTICLE NINE. MISCELLANEOUS PROVISIONS**

### **9.1 Costs**

Each Party shall pay its own legal costs with respect to the review and settling of this Agreement.

### **9.2 Successors and Assigns**

Except as hereinafter provided, a Party shall not assign this Agreement or its rights and obligations hereunder, in whole or in part, without the prior written consent of the other Party.

BioSoft may assign to a subsidiary or affiliate all or a part of its rights and obligations under this Agreement relating to the production and distribution in the Philippines of Nile Tilapia breeds, including any research related thereto, without the prior written consent of the Foundation. As used in this Article 9.2, the term “subsidiary” shall mean a corporation organized under the laws of the Philippines more than half of the subscribed and outstanding shares of which is owned by BioSoft, while the term affiliate shall mean any corporation organized under the laws of the Philippines at least a third of the subscribed and outstanding shares of stock of which is owned by BioSoft or by a subsidiary of BioSoft. Written notice of such assignment shall be given by BioSoft to the Foundation for the latter’s information.

This Agreement shall inure to the benefit of and be binding on the Parties, their respective successors and permitted assigns.

### **9.3 Arbitration**

Any dispute, controversy or claim arising out of or relating to this Agreement, or the breach, termination or invalidity thereof shall be finally settled by arbitration administered by the Philippine Dispute Resolution Center, Inc. (PDRCI) in accordance with the International Commercial Arbitration Rules as at present in force.

Any dispute, controversy or claim arising out of or relating to this Agreement governed by Norwegian law, shall be finally settled by arbitration in Oslo, Norway in accordance with the rules and procedures of chapter 32 of the Norwegian Civil Procedure Act.

### **9.4 Further Assurances**

Each Party shall execute and deliver all such documents and shall do all such things as shall be necessary for the complete performance of all its obligations under this Agreement and to give the other Party full benefit of the rights hereby granted.

### **9.5 Amendments**

No amendment, variation or modification of this Agreement shall be valid or binding unless made in writing and duly executed by or on behalf of all the Parties.

## **9.6 Non-Waiver**

No waiver by either Party of any default by the other Party in the performance of this Agreement shall operate or be construed as a waiver of any future default or defaults by that Participant whether of a like or of a different character.

## **9.7 Entire Agreement**

On and after the execution of this Agreement, all agreements and understandings between the Parties are contained in this Agreement which supersedes all prior agreements and understandings between the parties.

## **9.8 Severability**

If any provision of this Agreement shall in any respect be in violation of any law, rule, direction, regulation or order of government or be deemed void or voidable due to uncertainty or other reasons then to the extent necessary to avoid any violation of such law, rule, direction regulation or order or uncertainty such provision shall be severed and this Agreement as so modified shall continue in full force and effect. The Parties shall meet promptly after any such occurrence to decide on what action if any is required as a consequence.

## **9.9 Governing Law**

This Agreement shall be governed by and construed in accordance with the laws for the time being in force in the Philippines except in relation to the Shares of the Foundation in BioSoft shall be governed by the laws of Norway.

## **9.10 Counterparts**

This Agreement, and any certificates and other writing delivered in connection herewith, may be executed in any number of counterparts with the same effect as if the Parties had both signed the same documents, and all such counterparts and adopting documents will be construed together and will constitute one and the same instrument. The execution of this Agreement and any other writing by any Party will not become effective until counterparts hereto or thereof, as the case may be, have been executed by the Parties thereto, and executed copies delivered to each Party. Such delivery may be made by facsimile transmission of the execution page or pages thereof, to the other Party by the Party signing the particular counterpart, provided that forthwith after such facsimile transmission, an originally executed execution page or pages, duly authenticated by a Philippine consulate, if executed outside of the Philippines, is forwarded by prepaid express courier to each of the other Party by the Party signing the particular counterpart.

**IN WITNESS WHEREOF**, the Parties have caused this Agreement to be executed on the date first above written.

**GIFT FOUNDATION INTERNATIONAL, INC.**

**BIOSOFT AS**

By: **Basilio M. Rodriguez Jr.**  
Executive Director

By: **Dr. Øystein Lie**  
Founder and CEO



## Appendix 2

### Sample of WorldFish publications from work with GIFT

#### *Published:*

#### 2005

- Ponzoni, R.W., Hamzah, A., Tan, S., Kamaruzzaman, N., 2005. Genetic parameters and response to selection for live weight in the GIFT strain of Nile Tilapia (*Oreochromis niloticus*). *Aquaculture* 247: 203-210.
- Ponzoni, R.W., Hamzah, A., Kamaruzzaman, N., Khaw, H.L., 2005. Live weight genetic parameters in two production environments in the GIFT strain of Nile Tilapia (*Oreochromis niloticus*). *Proc. 16<sup>th</sup> AAABG*, p. 202-205.
- Ponzoni, R.W., Hamzah, A., Kamaruzzaman, N., Khaw, H.L., 2005. Response to selection in two production environments in the GIFT strain of Nile Tilapia (*Oreochromis niloticus*). *Proc. 16<sup>th</sup> AAABG*, p. 206-208.

#### 2006

- Charo-Karisa, H., Komen, H., Reynolds, S., Rezk, M.A., Ponzoni, R.W., Bovenhuis, H., 2006. Genetic and environmental factors affecting growth of Nile tilapia (*Oreochromis niloticus*) juveniles: Modelling spatial correlation between hapas. *Aquaculture* 255: 586-596.
- Charo-Karisa, H., Komen, H., Rezk, M.A., Ponzoni, R.W., Bovenhuis, H., 2006. Heritability estimate and response to selection for growth of Nile tilapia, *Oreochromis niloticus* in low input earthen ponds. *Aquaculture* 261: 479-486.
- Charo-Karisa, H., Komen, H., Rezk, M.A., Ponzoni, R.W., van Arendonk, J.A.M., Bovenhuis, H., 2006. Heritability estimate for growth and survival of Nile tilapia in fertilized earthen ponds. *Proceeding of 8<sup>th</sup> WCGALP*, Belo Horizonte, Brazil. Web access at [www.wcgalp8.org.br/wcgalp8/articles/paper/9\\_1815-1818.pdf](http://www.wcgalp8.org.br/wcgalp8/articles/paper/9_1815-1818.pdf).
- Fessehaye, Y., Komen, H., Rezk, M.A., Ponzoni, R.W., Bovenhuis, H., 2006. Effect of inbreeding on the performance of Nile tilapia (*Oreochromis niloticus*). *World Aquaculture Society meeting*, Bali, Indonesia.
- Khaw, H.L., Ponzoni, R.W., Hamzah, A., Abu-Bakar, K.R., Kamaruzzaman, N., Ismail, N., Jaafar, H., Nguyen, N.H., 2006. A comparison of GIFT and red tilapia for fillet yield and sensory attributes of flesh quality assessed by trained panel. *Proceeding of 8<sup>th</sup> WCGALP*, Belo Horizonte, Brazil. Web access at [www.wcgalp8.org.br/wcgalp8/articles/paper/9\\_98-2120.pdf](http://www.wcgalp8.org.br/wcgalp8/articles/paper/9_98-2120.pdf)
- Maluwa, A., Gjerde, B., Ponzoni, R.W., 2006. Genetic parameter and genotype by environment interaction for body weight of *Oreochromis shiranus*. *Aquaculture* 259: 47-55.

- Moehl, J., Brummett, R.E., Ponzoni, R.W., 2006. Genetic Management of Fish Hatchery Stocks in Sub-Saharan Africa. CIFA Occasional Paper 27. Food and Agriculture Organization of the United Nations, Accra, Ghana.
- Nguyen, N.H., Ponniah, A.G., Ponzoni, R.W., 2006. Potential applications of reproductive & molecular genetic technologies in selective breeding of aquaculture species. Development of Aquatic Animal Genetic Improvement and Dissemination Programs: Current Status and Action Plans, no. 1805, p. 15-21.
- Nguyen, N.H., Ponzoni, R.W., 2006. Perspectives from Agriculture: Advances in livestock breeding- Implications for aquaculture genetics. NAGA 29(3/4), p. 39-45.
- Ponzoni, R.W., Khaw, H.L., Abu-Bakar, K.R., Hamzah, A., Kamaruzzaman, N., Ismail, N., Jaafar, H., Nguyen, N.H., 2006. A comparison of GIFT and red tilapia for fillet yield and sensory attributes of flesh quality assessed by a panel of untrained consumers. Proceeding of 8<sup>th</sup> WCGALP, Belo Horizonte, Brazil. Web access at [www.wcgalp8.org.br/wcgalp8/articles/paper/9\\_99-2121.pdf](http://www.wcgalp8.org.br/wcgalp8/articles/paper/9_99-2121.pdf)
- Ponzoni, R.W., Nguyen, N.H., Khaw, H.L., 2006. Importance and implementation of simple and advance selective breeding programs for aquaculture species in developing countries. Proceeding of 8<sup>th</sup> WCGALP, Belo Horizonte, Brazil. Web access at [www.wcgalp8.org.br/wcgalp8/articles/paper/9\\_683-1814.pdf](http://www.wcgalp8.org.br/wcgalp8/articles/paper/9_683-1814.pdf).

## 2007

- Bartley, D.M., Brummett, R.E., Moehl, J., Ólafsson, E., Ponzoni, R.W., Pullin, R.S.V., 2007. Pioneering fish genetic resource management and seed dissemination programmes for Africa: adapting principles of selective breeding to the improvement of aquaculture in the Volta Basin and surrounding areas. CIFA Occasional Paper 29. Food and Agriculture Organization of the United Nations, Accra, Ghana.
- Charo-Karisa, H., Bovenhuis, H., Rezk, M.A., Ponzoni, R.W., 2007. Selecting Nile tilapia (*Oreochromis niloticus*) for growth in low-input environments. In: van der Zijpp, A.J., Verreth, J.A.J., Tri, L.Q., van Mensvoort, M.E.F., Bosma, R.H., Beveridge, M.C.M. (Eds.). Fishponds in farming systems. Wageningen Academic Publishers, p. 25-36.
- Charo-Karisa, H., Bovenhuis, H., Rezk, M.A., Ponzoni, R.W., van Arendok, J.A.M., Komen, H., 2007. Phenotypic and genetic parameters for body measurements, reproductive traits and gut length of Nile tilapia (*Oreochromis niloticus*) selected for growth in low-input earthen ponds. *Aquaculture* 273: 15-23.
- Eknath, A.E., Bentsen, H.B., Ponzoni, R.W., Rye, M., Nguyen, N.H., Thodesen, J., Gjerde, B., 2007. Genetic improvement of farmed tilapias: 1. composition and genetic parameters of a synthetic base population of *Oreochromis niloticus* for selective breeding. *Aquaculture* 273: 1-14.

- Khaw, H.L., Ponzoni, R.W., Danting, M.J.C., 2007. Estimation of Genetic Change in the GIFT Strain by Comparing Contemporary Progeny Produced by Males Born in 1991 or 2003. Proc. 17<sup>th</sup> AAABG, p. 111-114.
- Nguyen, N.H., Khaw, H.L., Ponzoni, R.W., Hamzah, A., Kamaruzzaman, N., 2007. Can sexual dimorphism and body shape be altered in Nile Tilapia by genetic means? *Aquaculture* 272S1: 38-46.
- Ponzoni, R.W., Nguyen, N.H., Khaw, H.L., 2007. Investment Appraisal of Genetic Improvement Programs in Nile tilapia (*Oreochromis niloticus*). *Aquaculture* 269: 187-199.
- Ponzoni, R.W., Nguyen, N.H., Khaw, H.L., 2007. Breeding program requirements in developing countries may differ depending on circumstances. In: van der Zijpp, A.J., Verreth, J.A.J., Tri, L.Q., van Mensvoort, M.E.F., Bosma, R.H., Beveridge, M.C.M. (Eds.). *Fishponds in farming systems*. Wageningen Academic Publishers, p. 59-67.

#### 2008

- Abu-Bakar, K.R., Ponzoni, R.W., Nguyen, N.H., Husin, N.M., Khaw, H.L., Kamaruzzaman, N., Hamzah, A., Yee, H.Y., 2008. Effect of thermal treatment on sex ratio, growth performance and survival in genetically improved farmed tilapia (GIFT strain, *Oreochromis niloticus*). In: Elghobashy, H., Fitzsimmons, K., Diab, A.S. (eds.) *Proceedings of 8th International Symposium on Tilapia in Aquaculture*, Cairo, Egypt, (vol. 1), Poster (No. 39 Abstract).
- Khaw, H.L., Ponzoni, R.W., Danting, M.J.C., 2008. Estimation of genetic change in the GIFT strain of Nile tilapia (*Oreochromis niloticus*) by comparing contemporary progeny produced by males born in 1991 or in 2003. *Aquaculture* 275: 64-69.
- Nguyen, N.H., Ponzoni, R.W., Abu-Bakar, K.R., Kamaruzzaman, N., Hamzah, A., Khaw, H.L., Yee, H.Y., 2008. Modeling fillet yield based on body measurements in genetically improved farmed tilapia (GIFT) *Oreochromis niloticus*. In: Elghobashy, H., Fitzsimmons, K., Diab, A.S. (eds.) *Proceedings of 8th International Symposium on Tilapia in Aquaculture*, Cairo, Egypt, (vol. 1), Poster (No. 53 Abstract).
- Ponzoni, R.W., Nguyen, N.H., Khaw, H.L., Kamaruzzaman, N., Hamzah, A., Abu-Bakar, K.R. and Yee, H.Y., 2008. Genetic Improvement of Nile Tilapia (*Oreochromis niloticus*) - Present and Future. In: Elghobashy, H., Fitzsimmons, K., Diab, A.S. (eds.) *Proceedings of 8th International Symposium on Tilapia in Aquaculture*, Cairo, Egypt, (vol. 1), p. 33-52.

2009

- Abu-Bakar, K.R., Hamzah A., Yee, H.Y., Nguyen, N.H., Ponzoni, R.W., 2009. Effects of heat treatment on male to female ratio in the GIFT strain. In Asia Pacific Aquaculture, Nov 3-6, 2009, Kuala Lumpur, Malaysia.
- Brummett, R., Ponzoni, R.W., 2009. Concept, alternative, and environmental considerations in the development and use of improved strains of tilapia in African aquaculture. *Reviews in Fisheries Science* 17 (1): 70-77.
- Kamaruzzaman, N., Nguyen, N.H., Hamzah, A., Ponzoni, R.W., 2009. Growth performance of mixed sex, hormonally sex reversed and progeny of YY male tilapia of the GIFT strain, *Oreochromis niloticus*. *Aquaculture Research* 40: 720-728.
- Khaw, H.L., Bovenhuis, H., Ponzoni, R.W., Rezk, M.A., Charo-Karisa, H., Komen, H., 2009. Genetic analysis of Nile tilapia (*Oreochromis niloticus*) selection line reared in two input environments. *Aquaculture* 294: 37-42.
- Khaw, H.L., Ponzoni, R.W., Hamzah, A., Kamaruzzaman, N., 2009. Genotype by environmental interaction for live weight between two production environments in the GIFT strain (Nile tilapia, *Oreochromis niloticus*). *Proc. 18<sup>th</sup> AAABG*, p. 60-63.
- Nguyen, N.H., Ponzoni, R.W., Abu-Bakar, K.R., Kamaruzzaman, N., Hamzah, A., Khaw, H.L., Yee, H.Y., 2009. Correlated responses in fillet weight and yield to selection for high growth in Genetically Improved Farmed Tilapia (GIFT strain) *Oreochromis niloticus*. In the 10<sup>th</sup> International Symposium on Genetics in Aquaculture (ISGA 2009) June 22-26, 2009, Bangkok, Thailand.
- Ponzoni, R.W., Khaw, H.L., Hamzah, A., Kamaruzzaman, N., Nguyen, N.H., 2009. Genetic evaluation of seven generations of selection for increased harvest weight in the genetically improved farmed tilapia (GIFT strain, *Oreochromis niloticus*). In the 10<sup>th</sup> International Symposium on Genetics in Aquaculture (ISGA 2009) June 22-26, 2009, Bangkok, Thailand.
- Ponzoni, R.W., Nguyen, N.H., Khaw, H.L., 2009. Genetic improvement programs for aquaculture species in developing countries: Prospects and challenges. *Proc. 18<sup>th</sup> AAABG*, p. 342-349.
- Rezk, M.A., Ponzoni, R.W., Kamel, E., John, G., Dawood, T., Khaw, H.L., Megahed, M., 2009. Selective breeding for increased body weight in a synthetic breed of Egyptian Nile tilapia, *Oreochromis niloticus*: Response to selection and genetic parameters. *Aquaculture* 293: 187-194

2010

Ponzoni, R.W., Khaw, H.L., Nguyen, N.H., Hamzah, A., 2010. Inbreeding and effective population size in the Malaysian nucleus of the GIFT strain of Nile tilapia (*Oreochromis niloticus*). Aquaculture 302: 42-48.

## Appendix 3

### Questionnaire

**Custodian(s) or owner(s) of the population** (include all contact details such as mailing address, e-mail, telephone and fax numbers)

**Physical location of the population** (full address)

**History of the population** [origin, date(s) of transfer of fish from origin, number of families and of fish per family received, any other information considered pertinent]

**Maintenance of the population to date** [e.g. number of generations since the original transfer of fish, mass spawning or pair mating or some other alternative, number of brood stock (number of males and number of females) used per generation in each generation since the original transfer took place]

**Current role of the population** [e.g. supplying brood stock to hatcheries, supplying fingerlings directly to producers, other?]

**Breeding plan** [selection objectives, selection method, individual fish identification (if any), procedure used for genetic evaluation, introduction(s) from other populations]

**Problems (if any) and perceived solutions** [e.g. low numbers, inbreeding, poor reproduction, deteriorated performance, other?]

### Future plans for the population

#### Impact assessment

1. Number of hatcheries to which GIFT brood stock has been supplied
2. Estimated number of fingerlings sold or provided to farmers by those hatcheries
3. Out of the farmers that are growing out GIFT, what proportion are small, medium or large farmers?
4. Estimated proportion of the total number of tilapia fingerlings grown out by farmers that are GIFT (this information will provide a clear indication of the impact GIFT is having on farmers)

**Any other information you may wish to supply that may be relevant in the assessment of the impact GIFT is having on tilapia production in your country or region.**

Thank you for your cooperation on this important matter for the future of GIFT.

## Appendix 4

### Policy on the transfer of Genetically Improved Farmed Tilapia (GIFT) from Asia to Africa by the WorldFish Center

#### Preamble

The Mission of The WorldFish Center is to ‘reduce poverty and hunger through improved fisheries and aquaculture’. We work to achieve this through relevant research, development and technology transfer, partnerships, capacity building and policy support. Genetic improvement by selective breeding is an area in which WorldFish has been active and successful. An improved strain of tilapia (*Oreochromis niloticus*) is one of the products the Center is especially proud of. The improved strain is called GIFT, an appealing acronym for Genetically Improved Farmed Tilapia. Consistent with our mandate of reducing poverty and hunger WorldFish believes that we should make such improved strains available to the Governments of those partner countries likely to benefit from growing a more productive tilapia strain. We have shared GIFT widely in Asia, but not to Africa despite the interest expressed by several countries. The decision to not distribute GIFT in Africa so far has been based on the wish to avoid harming valuable genetic diversity in centers of origin of tilapia species. Genetic diversity may be harmed if escaped GIFT fish successfully interbreed with wild tilapia. The natural diversity is important because it helps to sustain natural populations over time and it provides a source of genetic diversity for future selective breeding programmes.

#### Definitions

The term fish is used in a broad sense, to include invertebrate as well as vertebrate aquatic animals.

Allele is an alternative form of a gene (one member of a pair) that is located at a specific position on a specific chromosome. For example, the gene for color (albino or normal) in some fish exists in two forms, one form or allele for normal color (A) and the other for albino (a).

Center of Origin is the geographical native range of a species, containing wild populations with unique alleles that are important genetic resources for future genetic improvement, as well as for long-term persistence of the wild populations.

Gene frequency is a measure of the relative frequency of an allele at a genetic locus in a population. It is expressed as a proportion or a percentage.

Introgression is the incorporation of genes of one species or population into the gene pool of another by backcrossing of fertile hybrids with either parent species or population. For instance, escaped GIFT adults mating with native, wild *O. niloticus* adults would produce fertile hybrids, which could then backcross with more wild *O. niloticus* adults.

Selection is the choice of animals for use as parents.

Selective breeding is the process whereby parents are selected on the basis of one or more criteria, usually related to greater productivity.

### **Policy objective:**

This Policy is designed to help ensure that the results of our research and development of GIFT contribute directly towards poverty alleviation and reducing hunger among the poor in African countries. It also outlines steps that will help ensure that while benefiting the poor, countries transfer, multiply and disseminate fish in an environmentally responsible manner. Action should be consistent with the FAO Code of Conduct for Responsible Fisheries<sup>1</sup> and the Nairobi Declaration on 'Conservation of aquatic biodiversity and use of genetically improved and alien species for aquaculture in Africa' and the Dhaka Declaration on 'Ecological risk assessment of genetically improved fish'.

### **Guiding Principles**

- Genetic principles. The gene frequencies of the alleles favored by the selection programme will be different in the improved strains developed by selective breeding, from the wild, unimproved populations. Also, when selective breeding incorporates multiple sources of germplasm, the improved strains will have new alleles and may lose rare alleles present in local, wild populations. Both kinds of genetic change will happen whether the improved strain is developed in Africa, or in Asia and later transferred to Africa. Hence, the genetic risks posed by introducing GIFT to genetic resources in centers of origin in Africa are comparable to those posed by the local development of an improved strain.
- Environmental principles. The transfer, multiplication and dissemination of improved fish strains should be done in a way that minimizes the impact on the environment and on other fish populations.
- Social and humanitarian principles. WorldFish shall try to ensure that, wherever possible, poor farmers in developing countries capture the potential benefits from its research and development endeavors. In particular, it should be responsive to Government requests from such countries.

---

<sup>1</sup>see [www.fao.org/DOCREP/005/v9878e/v9878e00.htm](http://www.fao.org/DOCREP/005/v9878e/v9878e00.htm).

**Policy:**

1. WorldFish will make GIFT available to a government institution, provided the request comes from government, and if the request made to WorldFish meets the following conditions:
  - It has the approval of the relevant government authority of the country in question.
  - There is a well-defined strategy to maintain and disseminate the GIFT.
  - A government approved environmental risk assessment has been completed.
  - There is a clear plan for the management of environmental and biodiversity risks.
2. WorldFish will offer its services to oversee and provide advice on how to set up and maintain the GIFT stock, as well as to multiply and disseminate to farmers.
3. WorldFish will encourage, and help with, if necessary, the conduct of properly designed comparisons of GIFT with relevant local strains to evaluate the productivity advantage in favor of GIFT. WorldFish will also help with the conduct of properly designed genetic, environmental and disease risk assessments, as resources allow.
4. WorldFish's decision to support the transfer of GIFT to Africa is based on a commitment to link improving human well-being with conserving valuable aquatic biodiversity. This latter issue is becoming a high priority research and development area in the presence of a more active dissemination strategy of improved fish strains.
5. On request, and subject to resource availability, WorldFish will provide added support to assess, minimize and manage the risk of introgression of GIFT genes into wild populations. The accompanying document entitled 'Code of practice and manual of procedures for the introduction of GIFT to Africa' describes such measures. When help is sought an agreement specifying the obligations of the relevant parties will be drawn up.



## References

- Acosta, B.O., Gupta, M.V., 2010. The genetic improvement of farmed tilapias project: Impact and lessons learned. In De Silva, S.S., Davy, F.B. (Eds.). Success stories in Asian aquaculture, Springer, London, U.K, p 149-171.
- Acosta, B.O., Sevilleja, R.C., Gupta, M.V., 2006. Public and private partnerships in aquaculture: A case study on tilapia research and development. WorldFish Center Conference Proceedings, Contribution no. 1807, Penang, Malaysia, 72 pp.
- Asian Development Bank, 2005. An impact evaluation of the development of Genetically Improved Farmed Tilapia and their dissemination in selected countries. Operations Evaluation Department, Asian Development Bank, Manila, Philippines, 124 pp.
- Eknath, A.E., Hulata, G., 2009. Use and exchange of genetic resources of Nile tilapia (*Oreochromis niloticus*). Reviews in Aquaculture 1: 197-213.
- Gupta, M.V., Acosta, B.O., 2004. From drawing board to dining table: The success story of the GIFT project. NAGA, WorldFish Center Quarterly 27 (3 and 4): 4-14.
- Ponzoni, R.W., Nguyen, N.H., Khaw, H.L., 2007. Investment appraisal of genetic improvement programs in Nile tilapia (*Oreochromis niloticus*). Aquaculture 269: 187-199.
- Ponzoni, R.W., Nguyen, N.H., Khaw, H.L., Ninh, N.H., 2008. Accounting for genotype by environment interaction in economic appraisal of genetic improvement programs in common carp *Cyprinus carpio*. Aquaculture 285: 47-55.
- Ponzoni, R.W., Khaw, H.L., Nguyen, N.H., Hamzah, A., 2010. Inbreeding and effective population size in the Malaysian nucleus of the GIFT strain of Nile tilapia (*Oreochromis niloticus*). Aquaculture 302: 42-48.



**The Fridtjof Nansen Institute is a non-profit, independent research institute focusing on international environmental, energy, and resource management. The institute has a multi-disciplinary approach, with main emphasis on political science, economics, and international law. It collaborates extensively with other research institutions in Norway and abroad.**



**FRIDTJOF NANSENS INSTITUTT  
FRIDTJOF NANSEN INSTITUTE**

**Fridtjof Nansens vei 17, P.O. Box 326, NO-1326 Lysaker, Norway  
Phone: (47) 67 11 19 00 – Fax: (47) 67 11 19 10 – E-mail: [post@fni.no](mailto:post@fni.no)  
Website: [www.fni.no](http://www.fni.no)**