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# Genetic Improvement of Farmed Tilapias

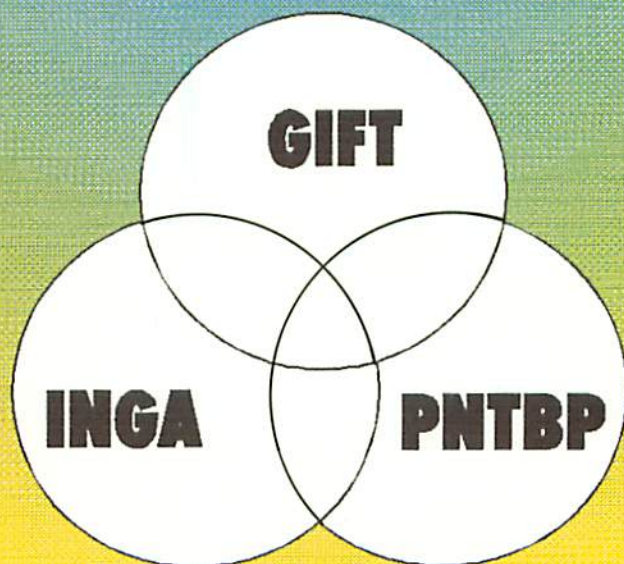
## PHASE II



(Financed by United Nations Development Programme,  
Division for Global and Interregional Programmes,  
GLO/90/016)

### PLAN OF PROJECT ACTIVITIES YEAR 2

January - December 1994



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Project No. GLO/90/016*

**GENETIC IMPROVEMENT OF FARMED TILAPIAS  
(GIFT) PHASE II  
(January 1993 to December 1997)**

**PLAN OF PROJECT ACTIVITIES - YEAR 2  
(January to December 1994)**

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February 1994

The GIFT Project is a collaborative research project implemented by ICLARM in cooperation with National Freshwater Fisheries Technology Research Center/Bureau of Fisheries and Aquatic Resources (NFFTRC/BFAR), Freshwater Aquaculture Center/Central Luzon State University (FAC/CLSU) and Institute of Aquaculture Research of Norway (AKVAFORSK) through NORAGRIC.

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## LIST OF ACRONYMS

ADB	-	Asian Development Bank
AKVAFORSK	-	Institute of Aquaculture Research of Norway
BAR	-	Philippine Bureau of Agricultural Research
BAS	-	Philippine Bureau of Agricultural Statistics
BFAR/NFFTRC	-	Bureau of Fisheries and Aquatic Resources/National Freshwater Fisheries Technology Research Center
DA	-	Philippine Department of Agriculture
EAP	-	External Advisory Panel
FAC/CLSU	-	Freshwater Aquaculture Center/Central Luzon State University
FRI	-	Bangladesh Fisheries Research Institute
GIFT	-	Genetic Improvement of Farmed Tilapias
ICLARM	-	International Center for Living Aquatic Resources Management
INGA	-	International Network on Genetics in Aquaculture
NORAGRIC	-	Norwegian Centre for International Agricultural Development
PCAMRD	-	Philippine Council for Aquatic and Marine Research and Development
PNTBP	-	Philippine National Tilapia Breeding Program
PSS	-	Provincial Service Stations of the Philippine Department of Agriculture
ROS	-	Regional Outreach Stations of the Philippine Department of Agriculture
TAC/CGIAR	-	Technical Advisory Committee/Consultative Group on International Agricultural Research
TPR	-	Tripartite Review
UNDP/DGIP	-	United Nations Development Programme/Division of Global and Interregional Programmes
UPLB	-	University of the Philippines at Los Baños, Laguna

## 1.0 INTRODUCTION

The GIFT project is a major strategic research initiative in applied genetics and breeding in tropical aquaculture. The Nile tilapia (*Oreochromis niloticus*) was selected as a pilot species for the GIFT project because of its worldwide importance in aquaculture importance and short generation time, which make it attractive for breeding work. The project was initiated in 1988 with financial support from the ADB and UNDP/DGIP.

The Phase I of the GIFT project (1988 to 1992) was successfully completed in July 1992. The expanded Phase II of five years was approved by the Governing Council of the UNDP/DGIP in May 1992. The Phase II officially began on January 1, 1993 and is scheduled to end in December 1997.

To further strengthen the GIFT II activities supported by UNDP, the President of ADB on 14 December 1993 approved a Technical Assistance Project entitled "Dissemination and Evaluation of Genetically Improved Tilapia Species in Asia" (Appendix 1). The ADB-TA is expected to begin in June 1994 and be completed in December 1996.

The GIFT Phase II will focus on technical aspects of genetic improvement, assistance in planning of national breeding programs, strengthening of national institutions in aquaculture genetics, and establishment of a mechanism for international cooperative exchange and evaluation of improved breeds and methodologies. The ADB-TA will complement and supplement the UNDP supported activities and will focus on the dissemination of methods and improved breeds developed under the GIFT project to selected developing member countries of ADB with emphasis on the assessment of economic performance of the improved breeds on farms.

This document described the GIFT Phase II work plans for the year 1994. Consultations with the External Advisory Panel (discussed below), with resource persons during the First Tripartite Review in November 1993, with representatives of Philippine national institutions and with the Research Coordinator of the International Network on Genetic in Aquaculture (INGA, discussed below), have led to better articulation of the GIFT Phase II objectives, activities and research priorities.

## **1.1. The GIFT Phase II - Summary of Objectives**

### **1.1.1. Development Objective**

The overall development objective is to increase the quantity and quality of protein consumed in low income rural and urban populations in tropical developing countries in all regions of the world and increase the income of low-income producers. As with future agricultural and aquacultural developments, the objective is to aim for sustainable systems, in harmony with the natural environment, to benefit producers and consumers.

The project focus is on Nile tilapia (*Oreochromis Niloticus*). However, this work, by providing useful methodologies, is expected to have similar benefits for other finfish species, especially carps. The planned program of collaborative research, training and information dissemination will greatly strengthen the capacity of national institutions to carry out relevant research and apply the findings in evolving self-sustainable national fish breeding programs.

### **1.1.2. Immediate Objectives and Activities**

For the purposes of clarity of presentation and appropriate linking of the range of activities, the five immediate objectives described in earlier documents are now reorganized into three major immediate objectives as follows:

**Objective 1:** To develop improved breeds of tilapia and provide those fish breeds to national testing programs and thence to fish farmers.

**Objective 2:** To strengthen national institutions in aquaculture genetics research.

**Objective 3:** To establish a mechanism for international exchange and evaluation of improved breeds and research methods.

The above objectives will be accomplished by pursuit of the following activities:

#### **Immediate Objective 1**

**Activity 1:** Selection and estimation of genetic gains.



**Approach:** Selection, specific genetic studies, estimation of response to selection, assessment of economic benefits through on-farm trials and survey of socioeconomics of tilapia farming.

**Activity 2:** Investigation of the genetics of economically important traits leading to efficient breeding and selection programs.

**Approach:** Development of methods and estimation of genetic parameters for growth, survival, age-at-first spawning, stress tolerance (salinity and low temperature), disease resistance; Development of methods for multi-trait selection.

**Activity 3:** Documentation and collection of promising strains for evaluation and possible inclusion in the on-going selection program and building up of new base populations.

**Approach:** Collection of several strains of Nile tilapia from different water bodies in Africa; Genetic characterization and evaluation; Cryopreservation of tilapia spermatozoa, Decisions on developing new breeds.

**Activity 4:** Database Management

**Approach:** Designing of databases; Development of user-friendly software for routine analysis of genetics data.

### Immediate Objective 2

**Activity 1:** Training and Assistance to plan national fish breeding programs

**Approach:** Organization of training workshops, post-graduate training, and specialized training for national scientists; Assistance to national institutions in planning national fish breeding programs.

The Philippine national tilapia breeding program will be the first to emerge and will serve as a possible model for other national programs.

### Immediate Objective 3

**Activity 1:** Establishment of cooperative linkages among various national programs (networking).

**Approach:** Consultation with the leaders of various national programs to determine the needs and interest for international networking; organization of network research planning workshops; and establishment of guidelines for network management.

#### **1.2. Review Mechanisms**

The progress and direction of research are reviewed periodically through the following mechanisms:

- (i) Review by the External Advisory Panel (EAP) convened by UNDP/DGIP.

In January 1993, the UNDP/DGIP instituted the EAP to annually review and monitor the progress and direction of the GIFT project. The panel members are: Dr. Graham A.E. Gall, Professor of Animal Breeding, Department of Animal Science, University of California, Davis; Prof. Vo Tong Xuan, Vice Rector, Cantho University, Cantho, Vietnam; Dr. Ziad Shehadeh, Executive Secretary, SIFR, Canada; and Dr. Bernard Chevassus, Director General, Institute de la Recherche Agronomique (INRA), France.

- (ii) Annual Tripartite Review (TPR) convened by UNDP/DGIP.
- (iii) Through regular ICLARM Program Reviews and the TAC/CGIAR External Program Reviews.

## **2.0 PROGRESS MADE AND CHALLENGES AHEAD**

### **2.1. Progress made in Year 1**

The progress report for the period July 1992 to October 1993 was submitted to UNDP/DGIP in November 1993. The significant accomplishments during Year 1 are:

1. Launching of the Philippine National Tilapia Breeding Program (PNTBP) by the President Fidel V. Ramos in May 1993.

2. Establishment of the International Network for Genetics in Aquaculture (INGA) in July 1993.

INGA was formally established in July 1993 following extensive consultations with the national program leaders during the UNDP/DGIP sponsored missions to ten countries (January to July 1993) led by Dr. D.V. Seshu and during the Network Planning Workshop in July 1993.

3. Immediately following the submission of the Progress Report - Year 1, the UNDP/DGIP convened the first meeting of EAP on 8-10 November 1993 and the First TPR on 10 November 1993.

The draft findings of the EAP (Appendix 2) were presented by the Advisory Panel Chairperson Dr. Graham A.E. Gall during the TPR on November 10, also convened by the UNDP/DGIP. The minutes of the TPR are in Appendix 3. The initial response to the EAP review drafted by the GIFT core team were noted by the ICLARM Board of Trustees during their special meeting in December 1993. Comments to the draft findings of EAP from AKVAFORSK in Appendix 4. The final report of the findings of the EAP was received by ICLARM on 20 January (Appendix 5). ICLARM's response to the final report is in Appendix 6.

In general, the GIFT team is pleased with the outcome of the review. The constructive criticism and suggestions by the EAP were extremely useful in prioritization of activities, project organization to enhance productivity, and development of a well structured work plan for 1994. At the same time, the confidence expressed by the EAP and UNDP/DGIP on the GIFT team's ability to implement a complex project will serve as an incentive to work harder and intensify the planned activities.

## 2.2. Challenges Ahead

The GIFT project has evolved from a relatively small research project during the GIFT Phase I to a major strategic research initiative in germplasm enhancement and breeding. The project has already laid the foundation for two new program activities: (a) the Philippine National Tilapia Breeding Program (PNTBP); and (b) the International Network on Genetics in Aquaculture (INGA). The PNTBP and INGA will remain closely associated with the GIFT project. Maintaining a healthy balance between the GIFT, PNTBP and INGA without compromising the planned strategic

research activities of GIFT will be a major challenge the GIFT core staff have to contend with during the next two to three years.

To ensure effective implementation, the various research and training activities are grouped into two major categories: 1) GIFT core research activities; and 2) activities in relation to the involvement of GIFT in PNTBP and INGA.

To implement GIFT core research activities and to build leadership in participating national institutions, the GIFT core team has been organized into seven working groups: (i) Planning of strategic research activities; (ii) Selection and Breeding; (iii) Management of Germplasm Reference Collection Center including the Cryopreservation Unit; (iv) Training, including organization of workshops; (v) Coordination of on-farm trials; (vi) Analysis of Socioeconomic impacts and (vii) Database Management including development of software for analysis of data. The composition and functions were described in the Progress Report - Year 1. A schematic diagram showing the relationship between the GIFT core research activities and activities as part of PNTBP and INGA is presented in Figure 1. A schematic diagram of the flow of genetic materials from the GIFT Project to the PNTBP and INGA is presented in Figure 2.

#### 2.2.1. GIFT Core Activities:

Activities related to strategic research (selection, screening of germplasm, and cryopreservation and gene banking) and database management are relatively well established (full dark boxes in Fig.1). Strategies to implement an expanded on-farm trials, socioeconomic analysis, and training activities are in preparation (incomplete boxes in Fig. 1). External resource persons (within Philippines and outside) will be contacted to develop framework for these activities.

Dr. Laurence D. Stifel (Director General, ICLARM) has assisted in development of a draft framework for economic and social impact analysis. Dr. Agnes Rola of the University of Philippines at Los Baños is the designated external resource person for this activity. The socioeconomic component of the GIFT Project will soon be under the leadership of ICLARM resource economist Dr. Mahfuz Ahmed, who will move from his present assignment in Bangladesh to Manila in late February 1994. Dr. Ahmed will also be the Coordinator (Economist) for the ADB Regional Technical

# Gift Core Activities

# PNTBP

# INGA

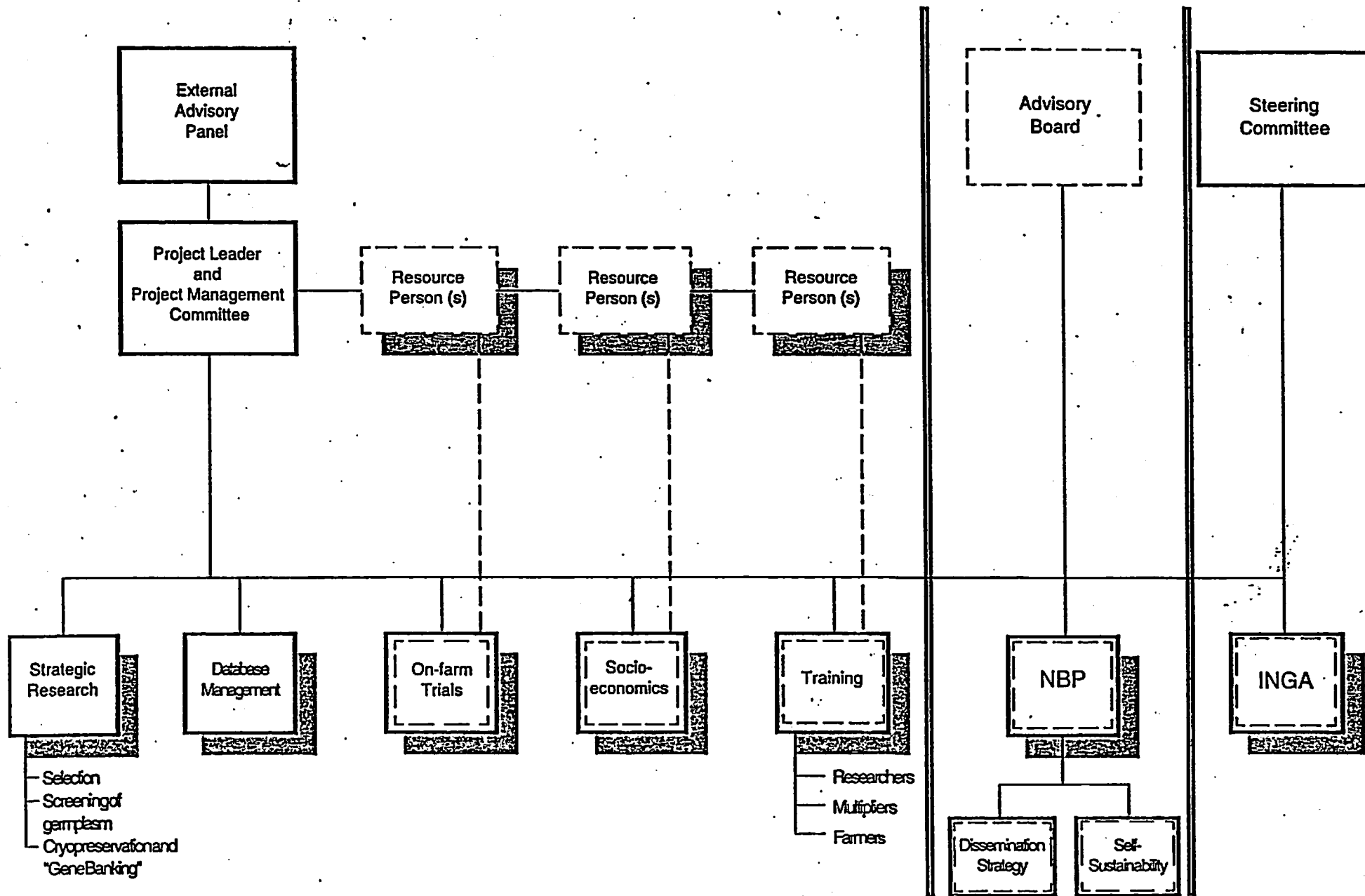


FIG.1 GIFT Project: Organization of Core Research Activities and Research Activities in Support of PNTBP and INGA

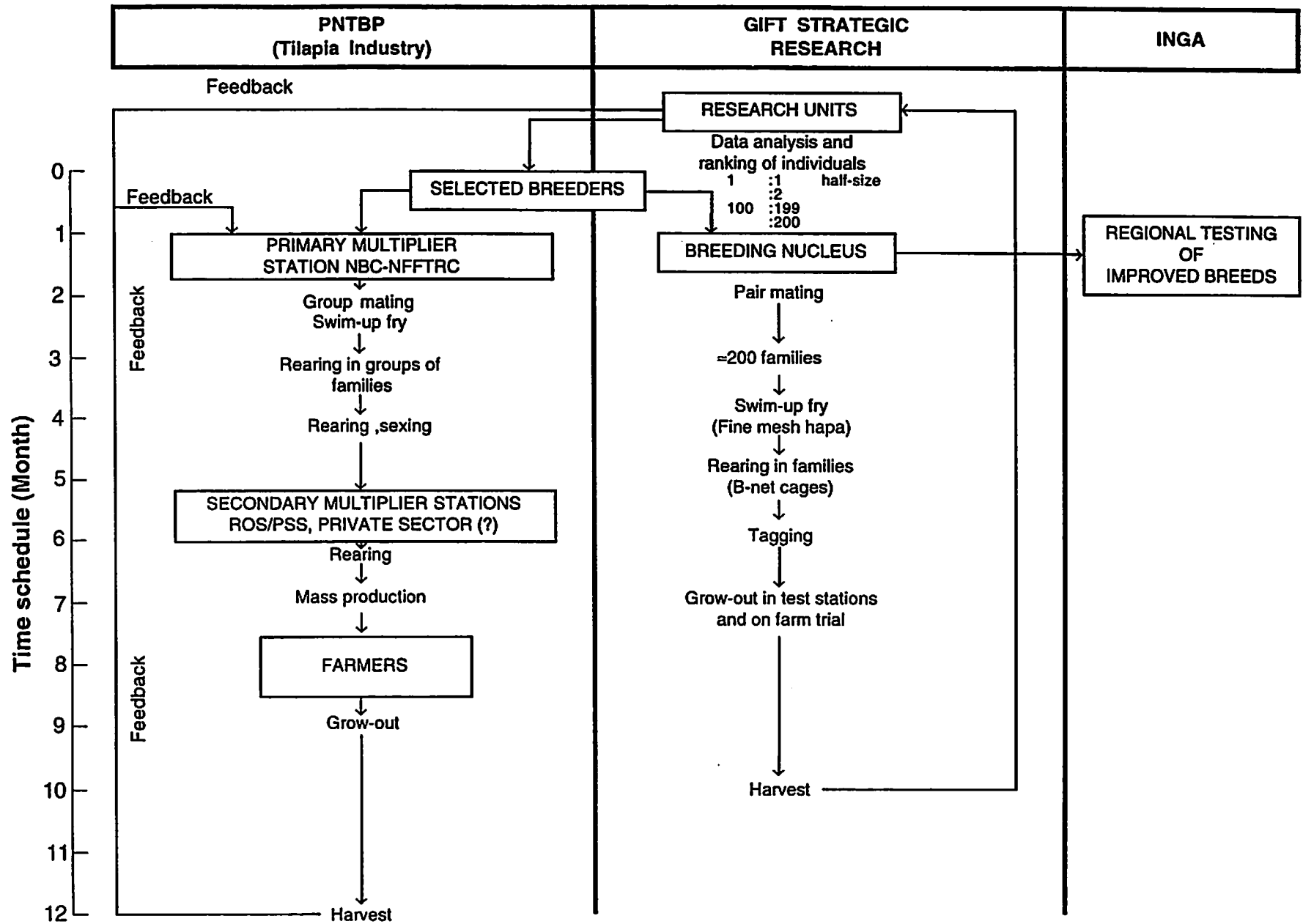


Fig.2. Schematic diagram of flow of genetic materials from GIFT project project to PNTBP and INGA.

Assistance Grant to ICLARM for "Dissemination and Evaluation of Genetically Improved Tilapia Species in Asia". The strategic research framework for socioeconomic analysis of improved breeds in the Philippines, developed under the GIFT Project, will then be applied in other countries (Bangladesh, China, Thailand and Vietnam) participating in ADB project.

To implement the expanded on-farm trials including the cost and returns analysis at farm level, a new Research Associate (Economist) has been hired with effect from 1 January 1993. On-farm trials will be carried out in cooperation with the Regional Outreach Stations (ROS) of the Philippine Department of Agriculture and the Provincial Service Stations (PSS). Technical backstopping will be provided by ICLARM resource economists.

Preparation of training materials and a framework for training of project staff and researchers participating in the INGA are underway. External resource persons (within Philippine and outside) will be contacted.

#### 2.2.2 PNTBP:

Development of a framework for the PNTBP comprising strategies for dissemination and for self-sustainability will initially be done as part of the GIFT core research activity. It is envisaged that the Philippine national lead agencies (NFFTRC/BFAR and FAC/CLSU) will soon be in a position to implement the PNTBP (probably from 1995 onwards). A revised framework for the PNTBP is presented in Appendix 7. Rapid dissemination of improved breeds to farmers will be done through the Primary and Secondary Multiplier stations. During a meeting in January 1994, the Department of Agriculture pledged substantial financial support for the PNTBP.

PNTBP is expected soon to become an active and productive participant of INGA.

#### 2.2.3. INGA:

One of the major objectives of the GIFT project (Objective 3) has been successfully accomplished with the formal establishment of INGA in July 1993. The eleven founding member countries of INGA are: from Asia - Bangladesh, China, India, Indonesia, Philippines, Thailand and Vietnam; and from Africa - Côte d'Ivoire, Egypt, Ghana and Malawi. ICLARM coordinates the network. Dr. Seshu has been serving as

the Research Coordinator since September 1993. The INGA Steering Committee has been formed in accordance with the principles and guidelines established during the Network Planning Workshop in July 1993 (Appendix 8). The Steering Committee consists of 12 members (one representative each from the 11 member countries plus one ICLARM representative). The INGA coordinator serves as the Executive Secretary of the Steering Committee.

The Challenges ahead are: to operationalize the mechanisms for exchange of genetic materials and research methods; building up of research partnership among members of INGA; and strengthening of national institutions participating in INGA.

#### 2.2.4. Relationship between GIFT and INGA

GIFT project is a strategic collaborative research partnership between ICLARM and Philippine national institutions (NFFTRC/BFAR and FAC/CLSLU). AKVAFORSK participates as an advanced scientific institution with experience in application of genetics to temperate aquaculture environments. The partnership between ICLARM and Philippine national institutions will continue through the duration of the GIFT Phase II. GIFT project will continue to focus on genetic improvement of Nile tilapia.

INGA, on the other hand, is a mechanism jointly established by national institutions and ICLARM for international cooperative exchange of germplasm (tilapias and carps at the first instance) and research methods. The GIFT project will utilize the INGA mechanisms, as would other INGA members, for obtaining new germplasm and testing of its research products in other national programs (such as improved Nile tilapia breeds, research methods and the Nile tilapia germplasm assembled in the live and cryopreserved genebank).

However, some of the initial activities of INGA such as, training of national institutions, standardization of research methods, will be carried out using resources provided by the UNDP to the GIFT project and the ADB-TA project. Meanwhile, efforts are underway to secure sustained financial support for INGA.

### 3.0 PLAN OF PROJECT ACTIVITIES - YEAR 2

The project activities during year 2 (1994) will focus on:



- Strategic research activities (objective 1). In addition to regular selection work, the focus will be on estimation of response to selection; and estimation of economic benefits of using improved breeds through expanded on-farm trials; and survey of the economics of tilapia farming.
- Training of scientists from various national programs.
- Providing technical support to the evolving PNTBP.
- Regional testing of improved breeds through INGA.
- Publications.

The priority areas of research and training for the year 1994 as identified by the EAP (presented in italics in the following sections) during their review in November 1993 will be pursued.

### 3.1. Core Research Activities

#### 3.1.1. Selection and Estimation of Genetic Gains (Objective 1, Activity 1)

##### 3.1.1.1. Selection (third generation)

Selection will be a regular core research activity. This will provide materials for other strategic research activities (estimation of genetic variation for age-at-first spawning, carcass quality, etc.), the PNTBP, and regional testing through INGA (see Fig. 2). The project is now in its third generation of selection. The regular activities include: estimation of breeding values, selection of individuals for breeding, nested pair mating to produce about 200 full sib (within 100 paternal half sibs) families, rearing of fry, tagging of individuals and release in test stations and in farms.

The overall objectives of selection are to: (a) estimate response to selection; (b) estimate genotype by environment interactions between growth performance in various practical tilapia farm environments; and (c) test release improved breeds in farmer participatory research as part of the PNTBP.

*A variety of controls have been used during the selection experiments. From 1994 onwards, as recommended by the EAP, only progeny from repeat mating of individuals from previous generations will be used as controls. The focus of*

*research during 1994 will be on the estimation of selection intensity.*

#### 3.1.1.2. Specific Genetic Studies

##### *Correlation between growth performance of families reared in cold (October to March) and summer months (April to July/Aug.):*

Two (seasonal) lines will be produced for testing in two different seasons of the years. This experiment was started in August 1993.

For the first line (for winter rearing), a total of 166 families were tagged and released in October 1993 for grow-out in four environments: earthen ponds in FAC and BFAR, cold environment in La Trinidad, and a brackishwater environment in Pagbilao. The brackishwater environment was flooded during the last typhoon (13 December 1993). A total of 5000 tagged individuals were lost. The fish from the remaining three environments will be harvested after a rearing period of about 120 days between 10 February to 12 March 1994.

Production of families for the second line (for rearing in summer months) from the same set of parents used during the first line has been delayed considerably due to the cool temperatures. As of 10 February a total of only 51, 34, 15 and 13 families (representing selected, repeat spawning controls, and the commercial strains 'Thailand' and 'Israel', respectively) have been produced. Mating of individuals to produce some more families will continue until the end of February. Stocking of families will be done in April 1994.

##### *Reliability of the use of controls in communal stocking:*

During the first and second generation selection experiments, control groups were reared communally with the selected individuals. The objective of this experiment is to determine whether communal stocking of control groups has any effect on their growth performance and thereby the estimated response to selection.

The experiment was started in August 1993 (along with the first line above). The control and selected individuals are being reared in triplicate hapas installed in ponds. The fish will be harvested in April 1994.

### 3.1.1.3. On-farm Trials

*As pointed by the EAP, the data generated during the 1992 and 1993 on-farm trials will be analyzed to include estimation of yields and the potential increase in incomes through the use of improved breeds.*

The on-farm trials during 1994 will be expanded to include socioeconomic profiles of the farmer cooperators and regular record keeping of various farm management activities. This will be done as part of the PNTBP and will be coordinated through the Regional Outreach Stations (ROS) of the Department of Agriculture and the Provincial Service Stations (PSS). The objective is to estimate the economic benefits of using improved breeds at farm level. This study will form the stage 3 of socioeconomic survey described in detail in the Progress Report - Year 1.

The scope of activities will be as follows:

- (i) Farmer cooperators will be chosen in consultation with the farm managers of the ROS and PSS. About 15 to 20 cooperators per region or a total of about 100 tilapia farms representing a range of farming systems and scale of operation will be covered.
- (ii) Determine the socioeconomic profile through questionnaires developed for the region wide socioeconomic survey (see below). The ROS and PSS managers will be trained to carry out the survey.
- (iii) The farmers will be trained through ROS and PSS to maintain simple farm records. The information to be gathered through farm records will consist of production inputs and outputs. Farm records will be monitored by GIFT staff and ROS and PSS over the production cycle.
- (iv) The pre-selected farmer cooperators will receive the improved breeds on priority basis through the ROS and PSS (the secondary multiplier stations of the PNTBP). 'Non-targeted' farmers receiving improved breeds will also be encouraged to maintain farm records.
- (v) *As suggested by the EAP, the post-release data will be collected for two years (or 2/3 production cycles) to provide initial estimates of economic impacts of switching to the improved breed.*

#### 3.1.1.4. Socioeconomic Survey

The rationale, objectives, scope and approach to this study were described in detail in the Progress Report - Year 1, submitted in November 1993.

*Following extensive consultations with the EAP, Dr. Stifel (ICLARM) and Dr. Rola (UPLB, Philippines), the survey questionnaires and sampling framework have now been amended.*

The survey will now cover representative samples of 130 grow-out operators and 59 hatchery operators in the 17 pre-selected provinces in Luzon (15) and Bicol (23). The baseline benchmark period for this survey will be the 1993 production cycle. The survey will be done in cooperation with the Philippine Bureau of Agricultural Statistics (BAS). Pre-testing of questionnaires and training and orientation of BAS enumerators will be done in March/April. Results of this benchmark survey will be used to identify farmer cooperators for the continuing on-farm trials

#### 3.1.2. New Traits (Objective 1, Activity 2)

The activities in 1994 will focus on genetic variation for age-at-first spawning, dressing percentage (meat yield). The rationale and approach were described in detail in the revised plan of project activities Year 1 and the Progress Report- year 1. These experiments are in various stages of completion. The target date for analysis of data is April/May.

A research framework for further investigation of the sexual dimorphism in growth performance and prospects for developing late maturing breeds will be developed in cooperation with Dr. John E. Thorpe of the Freshwater Fisheries Laboratory (Scottish Office Agriculture and Fisheries Development, U. K.) in May. Dr. Thorpe is well known for his work on plasticity of growth and stress induced growth variation in fish species.

#### 3.1.3. Collection of New Germplasm and Characterization (Objective 1, Activity 3)

*As suggested by the EAP, the focus here will be on: (i) possible new directions for breed development to accommodate genotype-environment interaction; and (ii) screening of new germplasm for stress tolerance traits (temperature and salinity). However, decision on whether to initiate development of a new breed from the current*

*GIFT nucleus or to form a new breed through screening of new germplasm will be done in stages.*

The specific genetic studies described in section 3.1.1.2 (Correlation of performance between lines reared in cold and summer months), and the screening of GIFT nucleus in cold and saline environments will address the need for new directions for breed development.

Screening of new germplasm collected in Egypt in October 1992, is being done in saline and cold environments. Tagged fingerlings obtained from pair mating of genetic materials collected from 5 different locations in Egypt have already been stocked (3 December 1993) in low temperature earthen ponds in La Trinidad (2 ponds; 300 and 260 m<sup>2</sup>); and four brackishwater earthen ponds in Hagonoy, Bulacan (400 m<sup>2</sup> each; 26 January 1994). Stocking in another brackishwater environment in Pagbilao, Quezon, was done on 10 February 1994.

Collection of new germplasm will be done on a selective basis for specific breeding purposes, and initiated only after promising germplasm is identified through pre-screening in the source country. All future collections will be done in cooperation with the INGA member countries. The modalities and protocols for collection and preliminary screening will be discussed during the INGA Steering Committee Meeting on 18-20 May 1994 in Bangkok, Thailand.

#### 3.1.3.1. Cryopreservation of Tilapia Spermatozoa

Priority will be given to cryopreserve the founder stocks collected during previous germplasm collection expeditions and the previously selected lines. Preparation of catalogue of families and other information pertaining to the broodstock to be distributed has already been initiated.

#### 3.1.4. Database Management (Activity 4)

Activities will include: *upgrading of Computer hardware to fully utilize the database (EAP recommendation)*; designing of data input formats for the on-farm trials and socioeconomic survey; compilation of all routine SAS application programs into a user-friendly software using the Screen Control Language of SAS under its AF module; development of a complete information system to integrate data handling and processing (the stand-alone GIFTSYS application); and training of project staff to

effectively utilize the database. The project has switched from SAS-OS2 to SAS-Windows with effect from January 1994.

### 3.2. Training (Objective 2)

#### 3.2.1. Training of Project Staff and Researchers in INGA

As recommended by the EAP, training of project staff and also researchers participating in the INGA will be given top priority. A short term intensive training program will be organized from September to mid-November. The training materials and training modules will be developed in consultation with experienced resource persons.

#### 3.2.2 Training of Farm Managers and Farm Cooperators

Training of ROS/PSS Farm Managers and Farmer Cooperators (described above), as part of the PNTBP, will be carried out in cooperation with Philippine Council for Aquatic and Marine Research Development (PCAMRD), BFAR, and the Bureau of Agricultural Research (BAR).

#### 3.2.3 Graduate Student Training

Students from Philippine national institutions will be identified for M.Sc. fellowships in June. These students will work in project-related activities.

#### 3.2.4. The Philippine National Tilapia Breeding Program (PNTBP)

The activities during 1994 will focus on full operationalization of the PNTBP (Appendix 7). There will be continuous coordination and monitoring of six multiplier stations and their farmer cooperators in Luzon. The two other regions of the Philippines (Visayas and Mindanao) will start to operate during the latter part of 1994. Feedback of information from farmers and multipliers to the Breeding Nucleus will also be coordinated.

In preparation for the implementation of the PNTBP, BFAR and ICLARM co-organized two separate meetings on January 20 -21. The first meeting was with the Undersecretary of the Department of Agriculture (DA) Mr. Joemari Gerochi to discuss the strategies for a self-sustainable PNTBP. The minutes of this meeting and principal recommendations are in Appendix 9. The DA has pledged substantial financial support

in support for the PNTBP. The second meeting with the Regional Directors of DA and Farm Managers of various ROS and PSS participating in the PNTBP focused on the strategies for dissemination and role of multiplier stations in the PNTBP. The minutes and recommendations are in Appendix 10.

Training of ROS and PSS Managers to orient them in the research methods and the process of dissemination will be organized in March. This training will be sponsored by the PCAMRD.

### *Role of Private Sector*

Experience from several development oriented research around the world has shown that the private sector in general have played a vital role in rapid dissemination of results and research products. Involvement of private sector is often considered essential for the success of technology developed. It is important, however, that the private sector understand and appreciate the mission of public-funded development oriented research. The targeted beneficiaries of such research are often the small-scale fish farmers. The challenge, then, is to identify common grounds for equitable participation of researchers and private sector.

Since the launching of the PNTBP by the President Fidel V. Ramos in May 1993, the private sector in the Philippines and elsewhere have shown increasing enthusiasm to participate in various activities of the GIFT project and the PNTBP. While the GIFT project has endeavored to build partnership with the private sector, it has yet to develop a framework for equitable cooperation without compromising its development objective.

Early on in the implementation of the PNTBP, the GIFT project in cooperation with the national lead agencies will organize consultative meetings with the private sector to determine a framework for collaboration. At present, only the public sector (ROS and PSS) have been identified as multipliers of improved breeds. The GIFT project realize that the private sector should also be brought into the program along with the public institutions. Exclusion of private sector at this formative stage of the PNTBP may prove counter-productive. It is also realized that the private sector will be more effective in realizing the GIFT project's goal of developing a self-sustainable PNTBP.

The plan of activities to involve private sector are as follows:

- (i) consultative meeting with national lead agencies and resources persons from development banks (ADB and World Bank) and Non-Government Organization (NGOs) to formulate a framework for discussion with private sector. This should identify the role of private sector, mode of cooperation, and security of improved breeds developed in the project.
- (ii) depending on the outcome of this consultation meeting, a meeting with private sector will be organized.

At present, several large private sector enterprises have offered to participate in the research aspects of the GIFT project, for example, in screening of new germplasm for salinity tolerance and testing of improved breeds under semi-intensive systems. The GIFT team would like to utilize this opportunity to work closely with private sector until a formal framework for long-term cooperation is established.

### 3.3. Activities in relation to involvement of GIFT in INGA

- (i) Regional testing of improved breeds and the germplasm assembled in the GIFT project. Protocols for transfer of genetic materials and testing will be developed during the upcoming mission from February 13 to 28 to India, Indonesia, Thailand and Vietnam. Similar protocols will be followed in Bangladesh and China.
- (ii) Initiation of the ADB funded project on the "Dissemination and Evaluation of Genetically Improved Tilapia Breeds in Asia" in June 1994.
- (iii) Preparation of a Procedures Manual based on the GIFT project experiences.
- (iv) Standardization of recording procedures for evaluation of genetic materials.
- (v) Organization of a national workshop in Bangladesh on "Broodstock Management and Procedures for Avoiding Inbreeding in Fish Hatcheries" from 26-27 March. Hands-on training of fish hatchery managers on methods of collecting data relevant for estimation of inbreeding rates, in preparation for the workshop, will be conducted



from 18-24 March. The workshop will be co-organized by the Bangladesh Fisheries Research Institute (FRI, Mymensingh) and ICLARM and will be sponsored through the USAID funded project on Aquaculture Development.

#### 4.0 PUBLICATIONS

There is a backlog of materials to be published. This will be pursued actively during year 2. The focus, however, will be on the following:

- (i) GIFT Project Technical Report (Manual of Procedures)
- (ii) Workshop Proceedings: Regional Workshop on Tilapia Genetics 1990; Meeting on International Concerns in the Use of Aquatic Germplasm (June 1992); and International Networking on Genetics in Aquaculture (1993).
- (iii) Major papers from the GIFT Phase I for presentation during the Fifth International Symposium on Genetics in Aquaculture (ISGA 5) in Halifax, Canada, in June 1994.

#### 5.0 CONSTRUCTION OF DEDICATED RESEARCH FACILITIES AND PROCUREMENT OF EQUIPMENT

Construction of dedicated research and breeding facilities will begin in February. Detailed plans and budgets have been submitted to UNDP/DGIP. Most of the equipment listed in Appendix 4 of the Plan of project activities (year 1) could not be procured in 1993 due to late release of funds. The revised list of equipment for purchase are given in Appendix 11.

#### 6.0 INTERNATIONAL TRAVEL

- INGA Missions (Drs. Seshu and Eknath): India, Indonesia, Thailand and Vietnam (13-28 February).
- National Workshop in Bangladesh (Dr. Eknath) - 18-29 March. (Travel expenses will be borne by organizers)

- SAS, Hongkong (Ms. Carmela Janagap: 15-20 February. For consultation on Screen Control Language and development of AF applications).
- Consultative Meetings by AKVAFORSK Scientist (Dr. Bentsen)- 7-15 March.
- Invited Resource Persons:
- Dr. J.E. Thorpe (9-13 May) - see section 3.1.2 above.
- Dr. G.A.E. Gall (in September for two weeks) - as training resource specialist. One or two more resource persons will be required (to be identified).
- INGA Steering Committee Meetings (Drs. Seshu and Eknath: 18-20 May, Bangkok, Thailand).
- Participation in the Fifth International Symposium on Genetics in Aquaculture (ISGA 5), Halifax, Canada (June 1994).
- International Marine Biotechnology Conference '94, Trondheim, Norway (Dr. Eknath) - August. Dr. Eknath will chair a session on "Marine Biotechnology and the Third World" (Travel expenses will be covered by the organizers).

## 7.0 EXPECTED OUTPUTS

### 7.1. Strategic Core Research

- Methods for measuring selection intensity;
- Magnitude of genetic gains, estimates of genotype-environment interaction; strategic decisions pertaining to breeds development.
- Estimates of genetic parameters for age at first spawning, tolerance to brackishwater and cold temperatures.
- Characterization of new germplasm and decisions pertaining to breeds development.

- SAS applications for routine analysis of genetic data.

## **7.2 Training**

- Training materials
- Trained Project staff
- Trained research partners participating in PNTBP
- Initiation of farm record keeping by farmer cooperators

## **7.3 PNTBP**

- PNTBP operational
- Identification of the role of private sector in PNTBP

## **7.4 Dedicated research and breeding facilities in national institutions**

## **7.5 Scientific Publications and Workshop Proceedings.**



ACTIVITY	1994											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Production of full-sib groups	X	X										
Tagging			X									
Pond preparation		X	X									
Stocking/rearing			X									
Daily observation for appearance of swim-up fry					X	X						
Experiment 2 (to determine genetic correlation between age at first spawning, growth and other reproductive traits)												
Fish Sampling, stocking and rearing by full-sib groups								X				
Observation of frequency of spawning								X	X	X		
Collection, counting and measurement of eggs/fry								X	X	X		
Scale collection and measurement								X	X	X		
Harvest										X		
Data analysis/report writing										X	X	
ii. Evaluation of New Germplasm from Egypt for Cold and Salinity Tolerance												
Inventory/Conditioning of stocks	X											
Tagging of individual fish	X											
Preparation of ponds	X											
Stocking and rearing		X	X	X	X							
Sampling		X	X	X	X							
Harvesting					X	X						
Analysis of Data						X	X					
C. Cryopreservation of Founderstock and Base Population												
Conditioning of breeders in tanks	X	X	X	X	X	X	X	X				

ACTIVITY	1994											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Collection of milt	X	X	X	X	X	X	X	X				
Cryopreservation of milt												
Preparation of catalog of families	X	X	X	X	X	X	X	X				
<b>D. On-farm Experiment</b>												
a. Compilation/Re-analysis of all data gathered in 1992/93	X	X	X	X	X	X						
b. Evaluation of two lines of breeding materials under farm condition	X	X	X	X	X	X	X	X	X			
c. Data Encoding				X				X				
d. Data Analysis					X					X		
<b>E. Tilapia Economic Survey</b>												
Revising and finalizing Stage 1 Technical Report	X	X	X									
Revising and finalizing Stage 2 Technical Report							X	X	X			
Establishing directory and validating GIFT cooperators	X	X	X									
Orienting GIFT cooperators to maintain farm records				X	X	X						
Disseminating GIFT fish						X	X				X	X
Monitoring of GIFT cooperators							X	X	X	X	X	X
<b>F. Collection of New Germplasm and Genetic Characterization</b>								X	X	X		
<b>G. Regional Testing of Improved Breeds</b>				X	X	X	X	X	X	X	X	X
<b>H. Network (INGA)</b>												
Steering Committee Meeting					X							



ASIAN DEVELOPMENT BANK-TECHNICAL ASSISTANCE  
FOR  
"DISSEMINATION AND EVALUATION OF GENETICALLY  
IMPROVED TILAPIA SPECIES IN ASIA"



**RESTRICTED**

**TAR:RES 26403**

**ASIAN DEVELOPMENT BANK**

*This Report has been prepared for  
the exclusive use of the Bank.*

**TECHNICAL ASSISTANCE  
(JSF-Financed)**

**FOR**

**DISSEMINATION AND EVALUATION OF GENETICALLY IMPROVED**

**TILAPIA SPECIES IN ASIA**

**December 1993**

## ABBREVIATIONS

BFRI	-	Bangladesh Fisheries Research Institute
DMC	-	developing member country (of the Bank)
GIFT	-	Genetic Improvement of Farmed Tilapia
ICLARM	-	International Center for Living Aquatic Resources Management
NAGRI	-	National Aquaculture Genetics Research Institute
NARI	-	national aquaculture research institute
NFFTRC	-	National Freshwater Fisheries Technology Research Center
PRC	-	People's Republic of China
PRFRI	-	Pearl River Fisheries Research Institute
RIA	-	Research Institute for Aquaculture
UNDP	-	United Nations Development Programme

## NOTE

In this Report, "\$" refers to US dollars.

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## I. INTRODUCTION

1. Fish provides 50 to 70 per cent of animal protein requirements in many countries of the Asian and Pacific Region and contributes substantially to the economies of the Bank's developing member countries (DMCs). Demand for fish has grown rapidly over the past few decades. As capture fisheries are increasingly overexploited, aquaculture—the cultivation of fish and other aquatic organisms in captivity—has assumed an increasingly prominent role in fisheries development.

2. Concerted research efforts are required to improve the efficiency and sustainability of aquaculture development and to increase aquaculture productivity. Recognizing the value of research in aquaculture production for social improvement and economic growth, the Bank financed a regional technical assistance (TA) in 1988 to establish a collaborative aquaculture research project on Genetic Improvement of Farmed Tilapia (GIFT) in Asia, with the participation of the Philippines and Thailand.<sup>1</sup> Subsequently, the United Nations Development Programme (UNDP) provided supplementary funding to strengthen the project. The GIFT project was successfully completed in August 1992 (see paras. 5 and 6). Consequently, many DMCs have requested Bank and UNDP support for establishing an international collaboration for fish genetics research in Asia and for dissemination of improved tilapia developed under the GIFT project to DMCs. In response, the International Center for Living Aquatic Resources Management (ICLARM) and the Bank have designed a regional TA<sup>2</sup> that will expand the GIFT project to enhance the fish genetics research capacities of selected DMCs and address the constraints on increasing the productivity and production efficiency of aquaculture.

## II. BACKGROUND AND RATIONALE

3. Aquaculture has been producing a growing proportion of the world's total fish supply, rising from about 7 per cent in 1975 to more than 10 per cent in 1990. It contributes towards improving people's nutrition, incomes and employment; reducing poverty; and increasing foreign exchange earnings and savings. The DMCs contribute about 80 per cent of the world's aquaculture production, and have established priority plans to expand and develop aquaculture.

4. Fish genetics research and breeding programs are an effective means of contributing to increases in the productivity and production efficiency of aquaculture. Genetic improvements are cumulative and permanent. The estimated benefits to cost ratio of genetic improvement programs in agriculture range from 5:1 to 50:1; these ratios probably will be exceeded for aquaculture genetics projects. Moreover, all such ratios are likely to be much higher in the developing world, both in economic and social terms, because of a low productivity base. Although fish genetics research for aquaculture only began in the 1970s, the possibilities for improving productivity through selective breeding are especially promising because fish have high fertility, short generation intervals and high genetic variability compared with other farmed animals.

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<sup>1</sup> RETA No. 5279, to the International Center for Living Aquatic Resources Management for Genetic Improvement of Tilapia Species in Asia, for \$475,000, approved on 8 March 1988.

<sup>2</sup> The regional TA first appeared in the ADB Business Opportunities in October 1993, and was confirmed by the governments of selected DMCs through ICLARM in November 1993.

5. The GIFT project, financed by the Bank in 1988, is a major initiative in applied genetics and breeding in tropical aquaculture in the Region. Tilapia, a tropical fish species that originated in Africa, was selected for the GIFT project because of its worldwide importance in aquaculture and short generation time, which makes it attractive for breeding work. Among the tilapia species, the Nile tilapia is the most widely preferred. It has major potential as an international food commodity and seems certain to become an increasing source of nutrition and income for many DMCs. This is particularly true for the poorer producers and consumers because of tilapia's low production cost and modest market price.

6. The primary objective of the GIFT project is to improve the breeds of farmed tilapia to increase aquaculture productivity in Asia. The project's sequential approach comprised systematic documentation of the status of Asian-cultured tilapia stocks; collection and transport of new germplasm from Africa to Asia with thorough quarantine; rigorous evaluation of the performance of different tilapia strains; selection of promising strains; and establishment of a base population of genetically improved high-yielding tilapia breeding lines for a wide range of farming systems and agroclimatic conditions. Within four years (1988 to 1992), the GIFT project<sup>1</sup> (i) developed a tilapia breed that outperformed the most widely cultured tilapia strain in Asia by 60 per cent for growth and survival in varied culture conditions, which should translate into more crops a year and substantial increase in fish production and incomes of fish farmers; (ii) developed scientific methods for fish breeding in the tropics; (iii) trained Philippine national scientists in fish genetics research; and (iv) identified potential and scope for further research and development.

7. The Bank's catalytic role initiated by ICLARM in this major research and development project has been widely acknowledged by regional and international institutions and many DMC governments. Given the success of the GIFT project, many external agencies<sup>2</sup> have initiated and supported applied fish breeding research in Asia, including Malaysia, Fiji, India and Indonesia, and in Africa. To further strengthen fish genetics research and breeding work, regional and international agencies concerned and many DMCs have requested from the Bank and UNDP support to (i) disseminate the genetically improved tilapia species to the DMCs and examine their sustainability and economic impact at the farm level, (ii) transfer knowledge and methods of fish genetics and breeding developed under GIFT to DMCs, (iii) establish an international collaboration for fish genetics research in Asia, and (iv) expand the genetic research to other commonly cultured fish species in Asia, such as carp.

8. The UNDP has agreed to provide further support for a second phase project, which would mainly emphasize the technical aspects of fish genetics improvement, establishment of an International Network on Genetics in Aquaculture<sup>3</sup> and planning national fish breeding programs. The Bank support will complement and supplement the UNDP support and focus on (i) disseminating improved tilapia species to selected DMCs; (ii) assessing their economic performance on farms, and the socioeconomic and

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<sup>1</sup> At the meeting of the Consultative Group on International Agricultural Research (CGIAR) in October 1993, the GIFT project was selected by the Technical Advisory Committee of the CGIAR as one of the four major breakthroughs in agriculture research in 1993.

<sup>2</sup> Including the Australian Center for International Agriculture Research, Danish International Development Agency, International Development Research Center of Canada, Japan International Cooperation Agency, and Norwegian Agency for International Development.

<sup>3</sup> Formally established in July 1993, involving 11 founding member countries, 7 of which are Bank DMCs: Bangladesh, People's Republic of China, India, Indonesia, Philippines, Thailand, and Viet Nam.

environmental impact of improved tilapia; and (iii) transferring scientific knowledge and information on fish genetics and breeding to DMCs, and planning national tilapia breeding programs.

9. The GIFT project has been implemented efficiently and has successfully developed high-yielding tilapia that could have significant impact on fish production in the Region. The GIFT project has also contributed to scientific advancement in fish genetics and breeding techniques that could be applied extensively in DMCs to enhance fish production. However, because of financial and time constraints, the GIFT project could not disseminate the genetically improved tilapia widely among DMCs or evaluate the social and economic benefits and environmental impact of the breeding program, which is important before commercial culture is undertaken. Thus, continuing support to consolidate the research results, disseminate improved tilapia species, transfer fish breeding technology, and assess economic, social and environmental impacts of improved tilapia, are essential to maximize the benefits of the Bank's earlier TA.

10. The TA is in line with the Bank's agriculture development strategy to develop aquaculture techniques to increase fish production and assist in agriculture diversification. The TA supports the Bank's medium-term strategy as it will address poverty reduction among poor fisherfolk in Asia. The TA will have significant impact on fish production in the Region by disseminating high-growth tilapia species and will contribute to scientific advancement in fish genetics and breeding.

11. The five participating DMCs will be Bangladesh, People's Republic of China (PRC), Philippines, Thailand and Viet Nam, which have been selected because they have (i) clear national strategies for aquaculture development, (ii) expressed strong interest in introducing improved tilapia species, (iii) existing facilities and manpower to conduct fish genetics research and breeding, (iv) high demand for tilapia, and (v) a lack of external financial support for the dissemination and evaluation of improved tilapia. The benefits of the GIFT project and the TA will be freely available to all DMCs.

### **III. THE TECHNICAL ASSISTANCE**

#### **A. Objectives**

12. The objectives of the proposed TA are to (i) increase incomes and improve the nutrition of small fisherfolk in the DMCs by distributing genetically improved tilapia species, (ii) transfer scientific knowledge and technology for tilapia genetics and assist DMCs in planning national tilapia breeding programs, and (iii) carry out detailed evaluation of the economic performance and environmental impact of the improved tilapia species.

#### **B. Scope**

13. The TA will assist in disseminating genetically improved tilapia fingerlings to Bangladesh, PRC, Philippines, Thailand, and Viet Nam. The five participating DMCs will follow rigorous quarantine procedures and will comply with the International Code of Practice in Fish Transfers so as to avoid harmful effects on local environments.

14. The TA will include a substantial human resources development component, which will provide training to 50-100 national scientists in applied fish breeding and genetics, and to 500-1,000 local fish breeding technicians and fish farmers in proper broodstock

management. The training will be conducted through short-term courses, exchange visits, and special seminars and workshops in the participating DMCs. The TA will also provide international expert services, necessary research equipment and training materials to the participating DMCs.

15. The TA will assess (i) the growth potential and economic performance of the improved tilapia species with emphasis on sustainability and economic viability, including farm-level production economics, cost-benefit analyses, and market studies; (ii) the socioeconomic impact of the improved tilapia species, which includes the analyses of pre- and post-introduction scenarios of the improved tilapia species, impact on production, income, employment, consumption and nutrition of the beneficiaries on farm-level and household-level, particularly on vulnerable rural groups such as women, resource-poor farmers and landless households; and (iii) the environmental impact of improved tilapia species, in accordance with the Bank's Environmental Guidelines for Selected Agriculture and Natural Resources Development Projects, Environmental Assessment Requirements and Environmental Review Procedures and ICLARM's International Concerns in the Use of Aquatic Germplasm, which includes the development of strategies to ensure quarantine safeguard, precautions against threats to resident biota, and conservation and utilization of local knowledge about fish genetics resources and habitats.

#### **C. Cost Estimates and Financing Plan**

16. The total cost of the TA is estimated at \$1.2 million equivalent, of which \$910,000 is the foreign exchange cost and \$290,000 is the local currency cost equivalent. The Bank has been requested to finance \$600,000, of which \$545,000 is foreign exchange cost and \$55,000 is the local currency cost equivalent, to cover services and travel of international experts, dissemination of improved tilapia, equipment and supplies relevant to research work, training and workshops. The TA will be financed by the Bank on a grant basis from the Japan Special Fund. The remaining foreign exchange cost of \$365,000 and local currency cost of \$235,000 equivalent will be borne by ICLARM and in-kind inputs from the participating countries to supplement Bank financing and to cover maintenance of research facilities, office and administrative costs and counterpart technical staff time. A breakdown of the cost estimates is given in Appendix 1.

#### **D. Implementation Arrangements**

17. ICLARM will be the Executing Agency for the TA. Leading national aquaculture research institutes (NARIs) of Bangladesh, PRC, Philippines, Thailand and Viet Nam will participate in implementing the TA. A description of ICLARM and selected NARIs is given in Appendix 2. A Project office will be established at ICLARM's headquarters in Manila for the implementation and administration of the TA. The Project office will be headed by a Project director (geneticist) assisted by a Project coordinator (fisheries economist) acceptable to the Bank and staffed adequately with administrative and supporting personnel. The Project director will be assigned by ICLARM from its regular staff and the Project coordinator will be recruited by ICLARM.

18. Four individual international experts will provide a total of 27 person-months of services in genetics, fisheries economics, sociology and resource environment science. ICLARM will engage individual international experts on terms and conditions acceptable to the Bank. National technical working teams at each participating NARI will be responsible for specific field activities. Each working team will be headed by a team coordinator, staffed with technical personnel and equipped with necessary research facilities. Each working team will be composed of fish hatchery specialists, fisheries economists, aquaculturists,

extension specialists, sociologists and environmental specialists. Each team will collaborate closely with ICLARM and international experts to conduct the field studies. The detailed terms of reference for the international experts and national technical working teams are given in Appendix 3. ICLARM will procure research equipment in accordance with the Bank's international shopping procedures, except for specific items for which direct purchase may be more appropriate.

19. Special seminars and training will be organized and carried out by ICLARM staff and international experts in collaboration with national working teams of the five DMCs and will focus on technology and methods of applied fish breeding and genetics and proper broodstock management practices to maximize the genetic potential of aquaculture stocks. A regional workshop will be held at the end of the TA implementation to review, consolidate and present the outcome of the TA (see Appendix 3).

20. The TA will be implemented in four phases over 30 months and is expected to begin in June 1994 and be completed in December 1996. Phase 1 consists of setting up the Project office, finalizing the detailed work program and inception report, and training and disseminating improved tilapia to five DMCs. Phase 2 comprises field work relating to technical, socioeconomic, economic and environmental evaluations and training. Phase 3 includes data processing and analysis, training and drafting final reports. Phase 4 consists of the review workshop and finalization of the proceedings.

21. The financial administration of the TA will be the responsibility of ICLARM, which will submit to the Bank semiannual statement of accounts to substantiate the TA funds expended. An audited statement of accounts for the funds will be submitted annually to the Bank. The funds will be drawn in three installments: the first, at the beginning of the TA; and the next two, after expenditures of the previous installment have been substantiated.

22. The Bank will closely monitor the implementation of the TA through half-yearly review meetings and a mid-term review mission (this intensity of supervision will be facilitated by ICLARM). ICLARM will submit to the Bank (i) an inception report at the end of the first phase of the TA, (ii) semiannual TA progress reports covering all activities under the TA, (iii) a draft final report before the final workshop, and (iv) a comprehensive final report incorporating significant findings and recommendations of the TA and the views of the workshop participants.

#### **IV. THE PRESIDENT'S DECISION**

23. The President, acting under the authority delegated to him by the Board, has approved the provision of a technical assistance, on a grant basis, to the International Center for Living Aquatic Resources Management in an amount not exceeding the equivalent of \$600,000 for the purpose of Dissemination and Evaluation of Genetically Improved Tilapia Species in Asia and hereby reports his action to the Board.

**ESTIMATED COSTS AND FINANCING PLAN**  
(in \$'000)

	ADB	ICLARM	DMCs	Total
<b>A. Personnel (ICLARM)</b>				
1. Project Director/Geneticist (6 person-months)	-	60	-	60
2. Project Coordinator/Fisheries Economist (12 person-months)	120	-	-	120
3. Socioeconomic Specialist (5 person-months)	25	25	-	50
4. Environment Specialist (4 person-months)	40	-	-	40
<b>B. International Travel</b>				
1. International experts <sup>a</sup>	50	50	-	100
2. DMCs	10	10	-	20
<b>C. Research Expenses</b>				
1. ICLARM				
a. Dissemination of Tilapia	20	15	-	35
b. Reports and Publications	10	5	-	15
c. Supplies and Communications	10	5	-	15
d. Office and Administrative Expenses	-	20	-	20
2. DMCs				
a. Research Work and Equipment	150	50	150	350
b. Reports and Publications	5 <sup>b</sup>	-	10	15
c. Communication and Administrative Expenses	20 <sup>b</sup>	-	10	30
d. Domestic Travel	30 <sup>b</sup>	-	20	50
<b>D. Training and Workshop</b>				
1. Training	20	45	10	75
2. Workshop <sup>c</sup>	20	40	10	70
<b>E. Contingencies</b>				
	70	40	25	135
<b>TOTAL</b>	<b>600</b>	<b>365</b>	<b>235 <sup>b</sup></b>	<b>1200</b>

DMC - developing member country

ICLARM - International Center for Living Aquatic Resources Management

<sup>a</sup> Including expenses for domestic travel for international experts.

<sup>b</sup> Represents the local currency cost.

<sup>c</sup> Including expenses for international travel for workshop participants for the selected DMCs.



**INTERNATIONAL CENTER FOR LIVING AQUATIC RESOURCES MANAGEMENT  
AND  
NATIONAL AQUACULTURE RESEARCH INSTITUTES**

**A. International Center for Living Aquatic Resources Management**

1. The International Center for Living Aquatic Resources Management (ICLARM) is an international, nonprofit, non-government scientific and technical organization that conducts, stimulates and accelerates research on all aspects of fisheries and other living aquatic resources. ICLARM was established in 1975 as a project of the University of Hawaii, and was incorporated in January 1977 as an independent institution with headquarters in Manila. It relied initially on core support from the Rockefeller Foundation. The support base has now broadened and includes various bilateral sources such as Australia, Denmark, France, Germany, and United States, as well as a number of regional and international agencies, including the Bank, United Nations Development Programme and the World Bank. In May 1992 ICLARM was formally accepted by the Consultative Group on International Agricultural Research as a member. It is the only international, autonomous research center in the tropics that deals with the full range of interdisciplinary research issues in fisheries and aquaculture. The interests of ICLARM are primarily in developing countries worldwide, and its objectives are:

- (i) to conduct and assist with research on fish production, management, preservation, distribution and utilization to assist peoples of the world in meeting their nutritional and economic needs;
- (ii) to improve the efficiency of culture and capture fisheries through coordinated research, education and training, linked with appropriate development and extension programs;
- (iii) to upgrade the social, economic and nutritional status of poor people in less developed areas through improvement of small-scale fisheries;
- (iv) to encourage labor-intensive and low-energy input systems where appropriate;
- (v) to publish and disseminate research findings in support of the Center's objectives; and
- (vi) to organize and conduct conferences, forums and workshops for discussion of current problems and for the exchange of research results.

2. At present, ICLARM is headed by a Director General. ICLARM's core staff consists of internationally recruited scientists drawn from diverse disciplines in biological and social sciences and economics. In addition, provision is made for interns, consultants and visiting fellows, contributing to breadth of competence and flexibility. Currently, ICLARM has 22 senior professional staff members, 38 mid-level professionals and 160 support staff in its programs. Two-thirds of professional staff are project-funded. To maintain the present low

overhead, flexibility, interdisciplinary approach and absence of burdensome administrative procedures, ICLARM intends to remain small, selecting only critical research targets to ensure the most effective use of support funds.

3. ICLARM's programs initially focus on Asia and the Pacific and sub-Saharan Africa. The current programs at ICLARM are:

- Inland Aquatic Resource Systems
- Coastal and Coral Reef Resource Systems
- Information

4. ICLARM has worked with the Bank on two regional technical assistance projects<sup>1</sup> during 1980-1982, and has also received technical assistance funds from the Bank for research on (i) rice-fish farming systems,<sup>2</sup> and (ii) genetic improvement of farmed tilapia.<sup>3</sup> ICLARM has implemented and completed these projects efficiently and in conformity with Bank requirements.

## **B. National Aquaculture Research Institutes (NARIs)**

### **1. Bangladesh: Bangladesh Fisheries Research Institute**

5. The Bangladesh Fisheries Research Institute (BFRI), which was established in 1985, is responsible for carrying out applied and strategic research in freshwater aquaculture and fish and marine capture fisheries. Its freshwater aquaculture research station in Mymensingh occupies an area more than 40 hectares of land. BFRI has been actively involved in applied fish breeding and genetics research since 1988. At present, BFRI has 2 senior geneticists and 15 scientists.

### **2. People's Republic of China: Pearl River Fisheries Research Institute**

6. Pearl River Fisheries Research Institute (PRFRI) was established in 1979. It is an integrated research institution responsible for science and technology for the development of freshwater fishery production in the tropical and subtropical zones of the Pearl River water area. PRFRI has six divisions: fishery resources, fish breeding, culture technology, fish disease, fishery environment and a testing center. It has 108 professional staff members, of whom 16 are senior and 40 are at intermediate level.

### **3. Philippines: National Freshwater Fisheries Technology Research Center of the Bureau of Fisheries and Aquatic Resources**

7. The National Freshwater Fisheries Technology Research Center (NFFTRC) of the Bureau of Fisheries and Aquatic Resources is the designated national broodstock center. ICLARM's collaborative research project on Genetic Improvement of Farmed Tilapia

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<sup>1</sup> RETA No. 5068: Workshop on Appropriate Technology for Alternative Energy Sources in Fisheries, for \$70,000, approved on 7 July 1980; and RETA No. 5109: Research and Training in Aquaculture, for \$220,000, approved on 30 August 1982.

<sup>2</sup> RETA No. 5245: Research on Rice-Fish Farming Systems, for \$350,000, approved on 15 April 1987.

<sup>3</sup> RETA No. 5279: Research on Genetic Improvement of Farmed Tilapia in Asia, for \$475,000, approved on 8 March 1988.

(GIFT) is based at NFFTRC in Muñoz, Nueva Ecija. The facilities include a germplasm reference collection center, cryopreservation laboratory, and tilapia hatchery and production facility covering an area of about 25 ha. At the national level, GIFT is considered to have been one of the most successful projects for its implementation arrangements and relevance to targeted beneficiaries, i.e., the small-scale resource-poor farmers. NFFTRC and the Freshwater Aquaculture Center of the Central Luzon State University have developed strategies for a self-sustaining National Tilapia Breeding Program for the dissemination of improved breeds developed under GIFT.

4. **Thailand: National Aquaculture Genetics Research Institute**

8. The National Aquaculture Genetics Research Institute (NAGRI) was established in 1989 to serve as the nodal institute for genetics research on a wide range of aquatic species such as tilapia, catfish, common carp, giant freshwater prawn, and marine shrimp. NAGRI administers three major research units: quantitative genetics, population genetics and genetic engineering. The Institute is temporarily located in the In Kasetsart University complex, but will move to Pathumthani Province where a major research facility covering an area of about 90 ha is being constructed. In addition, four regional centers for multilocation trials have been developed. NAGRI has well qualified staff: 4 geneticists with Ph. D. and 6 with M.S.

5. **Viet Nam: Research Institute for Aquaculture No. 1**

9. The Research Institute for Aquaculture No. 1 (RIA 1), at Ha Bac (13 kilometers from Hanoi) was established in 1963. The facilities include laboratories for research in genetic selection, biochemistry, fish diseases and water pollution; a modern hatchery; a feed mill; and a fish museum. The Ministry of Fisheries has plans to develop RIA 1 as an international research and training center. RIA 1 has a strong team of fish geneticists: 3 senior scientists with Ph. D. in genetics, and about 10 scientists with M.S. in genetics. RIA 1 has a good record of genetics research especially pertaining to silver carp and common carp.

10. The five NARIs have been selected to participate in the proposed TA based on their:

- (i) research capability in aquaculture, including fish genetics and breeding;
- (ii) appropriate location and conditions for tilapia research and culture;
- (iii) existing research facilities and qualified staff for carrying out fish genetics research and breeding; and
- (iv) expression of interest to participate in the TA.

## TERMS OF REFERENCE

### A. Introduction

1. The technical assistance (TA) will complement United Nations Development Programme (UNDP) support, which mainly emphasizes the strategic research activities proposed under the International Network on Genetics in Aquaculture. It is a logical follow-up to the Bank's RETA No. 5279: Genetic Improvement of Farmed Tilapia in Asia (GIFT) with a focus on the dissemination and economic, social, and environmental evaluations of genetically improved tilapia species and the transfer of scientific knowledge and technology on fish genetics. The important lessons learned, positive and negative, from plant and livestock breeding should form the foundation for an environmentally sound improved fish breeds dissemination program.

2. The international experts to be provided or recruited by International Center for Living Aquatic Resources Management (ICLARM) for the TA will provide 27 person-months of services. The international experts will include the following: Project director/geneticist (6 person-months), Project coordinator/economist (12 person-months), sociologist (5 person-months) and environment specialist (4 person-months). They will work as a team to assist in planing and implementing the TA and in realizing the overall development objectives of the TA. The general tasks assigned to this team of experts are to (i) prepare a policy framework for dissemination of improved fish species, taking into account the technical, social, economic, environmental, and institutional aspects; and (ii) assist the national scientists and administrators in developing self-sustaining national fish breeding programs through appropriate training and information exchange. In carrying out these tasks, relevant Bank guidelines should be followed.

3. The local technical personnel will be provided or recruited by the participating national aquaculture research institutions (NARIs) of the five selected developing member countries (DMCs). The national technical teams should ideally comprise fish hatchery specialists, fisheries economists, aquaculturists, extension specialists, sociologists and environment specialists. Liaison with farmers is a key element of the TA. The national technical teams will work closely with the Project coordinator and the Project director in implementing the country-specific study components.

### B. Terms of Reference for International Experts

4. The terms of reference will include, but not necessarily be limited to, the following:

1. Project Director/Geneticist (6 person-months)

5. The Project director will be responsible for the overall strategic research thrust on applied fish genetics and breeding. The Project director will:

- (i) provide overall scientific leadership and coordination to ensure complementarity with other international projects, and especially with the activities under the UNDP project;
- (ii) review the current status of tilapia research and development and fish breeding programs in the five participating DMCs;
- (iii) in consultation with the international experts and project coordinator, assist ICLARM's Training Coordinator and Information Division in the preparation of appropriate training materials and in the organization of training programs and regional workshops;
- (iv) work closely with the Independent Advisory Panel on International Fish Transfers to ensure compliance with the international code of practices, and quarantine protocols;
- (v) prepare detailed procedures for dissemination of the genetically improved tilapia species and cooperate with the NARIs to organize and conduct the dissemination of improved tilapia to the five participating DMCs;
- (vi) in collaboration with international experts, particularly the Project coordinator/fisheries economist prepare research programs for comparative evaluation of economic performance and the socioeconomic and environmental impacts of improved and local tilapia breeds;
- (vii) in coordination with the NARIs, prepare genetic materials for transfer to and testing in the five participating DMCs;
- (viii) identify the future needs of fish genetics research and breeding programs for the five participating DMCs; and
- (ix) recommend sustainable approaches for further improvement and development of tilapia species and fish genetics research and fish breeding programs in Asia, in collaboration with Project coordination.

**2. Project Coordinator/Fisheries Economist (12 person-months)**

6. The Project coordinator/fisheries economist will undertake the following:

- (i) prepare the Project inception report including detailed workplan, overall implementation schedule, and research procedures and guidelines for TA implementation in each of the five participating DMCs in collaboration with the Project director;
- (ii) review the current status of commercial tilapia production and evaluate the present role of tilapia production in rural economic development in the five participating DMCs;
- (ii) be responsible for the assessment of the economic performance of improved tilapia breeds, which will include (a) conduct of an initial review of

the research scope and distribution of study sites in the five participating DMCs in close consultation with the national teams and the project director; (b) preparation of questionnaires and/or farmers' notebooks for monitoring farm activities (inputs, outputs and economic benefits); (c) analysis of production economics, including input-output, economic benefits and cost-return for selected farms; (d) estimation of economic benefits that may be derived from disseminating the improved tilapia breeds and quantification of the projected number of direct and indirect beneficiaries; (e) determination of appropriate training needs for farmers and national researchers; and (f) identification of possibilities for commercializing the improved tilapia species in rural areas of the five participating DMCs;

- (iii) in consultation with the national team leaders, (a) assess the existing infrastructure and facilities for distributing of improved fish breeds, including hatcheries, grow-out and marketing channels, and (b) assess the needs and opportunities for developing self-sustaining national fish breeding programs;
- (iv) in consultation with the Project director (geneticist), channel relevant technical advice and recommendations to NARIs;
- (v) provide technical guidance, training and supervision of research to the NARIs of the five participating DMCs;
- (vi) organize training programs and regional workshops; and
- (vii) prepare the Project progress reports and final report to include all outputs and main findings of the TA research and regional workshops and recommendations for future improvement and development of the tilapia species and fish genetics research for aquaculture development.

### 3. Sociologist (5 person-months)

#### 7. The sociologist will:

- (i) examine the current socioeconomic status of tilapia farming, including numbers of tilapia farmers, their income and land/fish pond holding, their needs and demands, and the women's participation in tilapia farming;
- (ii) coordinate with the national teams to identify target beneficiary groups, rural poor and women in particular, that may participate in, or be affected by, the dissemination of the improved tilapia species;
- (iii) consult with the national teams and target farmer groups on the concept and design of the TA and its implementation arrangements;
- (iv) assist the project coordinator in developing methods and procedures and in designing survey kits, data collection formats and data analysis for socioeconomic studies;

- (v) review and analyze relevant socioeconomic data in specific study areas in the five DMCs—emphasis should be on potential positive and negative impacts (social, cultural, economic, financial, etc.) of the adoption of genetically improved tilapia;
  - (vi) develop a monitoring and evaluation program for continuous feedback of the impact of the Project on tilapia production and on the target beneficiaries; and
  - (vii) prepare a consolidated topic study report on the socioeconomic impacts of disseminating genetically improved tilapia species in participating DMCs, present the study findings in the regional workshop, and recommend future strategies for increasing the income and improving the nutrition status of poor rural farmers through aquaculture development.
4. **Environment Specialist (4 person-months)**
8. The environment specialist will:
- (i) prior to Project implementation, review all available data for the proposed Project locations to determine the actual or potential negative or positive environmental impacts of disseminating improved tilapia species and recommend appropriate measures to avoid negative impacts through design and implementation of the TA;
  - (ii) prepare a water and soil sampling and monitoring program at the beginning of the Project to obtain the data required for the environmental assessment of improved tilapia;
  - (iii) provide workplan and guidelines for transfer of the improved tilapia species to each participating DMC after detailed consultation with the Independent Advisory Panel set up by ICLARM for the GIFT project. This includes recommendations on appropriate quarantine programs and compliance with the International Code of Practice in Fish Transfers;
  - (iv) assess the sustainability of fish genetic improvement programs as proposed under the TA across a spectrum of needs and opportunities represented by the prevailing conditions in the five participating DMCs;
  - (v) review and analyze the environmental data collected during the country studies and prepare a consolidated topic study report on the environmental impacts of disseminating improved tilapia species and present the report in the regional workshop; and
  - (vi) at the conclusion of the Project, prepare an overall environmental assessment of the dissemination of the improved tilapia species, taking into account the critical parameters listed in the Bank's Environmental Guidelines for Selected Agricultural and Natural Resources Development Projects and Environmental Assessment Requirements and Environmental Review Procedures, and develop and recommend strategies and measures to

ensure environmental sustainability in the development of fish genetics for aquaculture, particularly of tilapia production.

**C. Terms of Reference for National Teams in the Five Participating DMCs**

9. The national technical teams will be set up in the following designated NARIs of the five participating DMCs:

Bangladesh	Fisheries Research Institute - Mymensingh.
PRC	Pearl River Fisheries Research Institute - Guangzhou.
Philippines	Bureau of Fisheries and Aquatic Resources/National Freshwater Fisheries Technology Research Center-Muñoz; and Freshwater Aquaculture Center of the Central Luzon State University-Muñoz.
Thailand	National Aquaculture Genetics Research Institute - Bangkok.
Viet Nam	Research Institute for Aquaculture No. 1 - Ha Bac.

10. These national technical teams will be responsible for the specific site studies and conduct of the field investigations relevant to the TA. The terms of reference for the national teams will include, but not necessarily be limited to, the following:

- (i) Collaborate with the international experts to plan and conduct field investigations and prepare topical reports on specific aspects of Project components and carry out a tilapia breeding program in selected specific sites with the guidance of the international experts.
- (ii) Collect, review and compile available socioeconomic data for the various Project locations and prepare a preliminary classification of the farming systems and the various groups for the study.
- (iii) Identify farmer cooperators and select the target farm sites for the planned experiments. The farmer cooperators selected should represent a broad spectrum of farming systems and income groups.
- (iv) Actively encourage the involvement of small-scale poor farmers, farmer organizations, cooperatives, government and non-government organizations in the discussion and participation in the Project.
- (v) Receive and multiply genetically improved tilapia developed under the GIFT project for national planned experiments.



- (vi) Ensure quarantine safeguards as suggested by the Project and the Independent International Advisory Panel.
- (vii) Collect, compile and review all environmental data for Project locations.
- (viii) Collect, compile and review the estimated production costs for the various farming systems and income groups.
- (ix) Organize local training workshops wherever necessary, and participate in the regional workshop as resource groups and present the research findings in the workshop.
- (x) In collaboration with international experts, assist the national governments in preparing national tilapia breeding programs.
- (xi) Assist the Project coordinator to prepare and finalize the TA final report.

**D. Regional Workshop**

11. A five-day regional workshop will be held in Bangkok, Thailand at the end of the TA implementation. The workshop will be organized and conducted by ICLARM with the assistance of the international experts of the TA and the national team coordinators. Representatives of the participating DMCs, ICLARM and the Bank will attend the workshop. Representatives of other DMCs, regional and international agencies will be invited to participate in the workshop at their own expense. The workshop will review, consolidate and present the outcome of the TA; recommend sustainable approaches for further improvement and development of tilapia species, fish genetics research and tilapia breeding program in Asia.

**Genetic Improvement of Farmed Tilapias - Phase II**

**DRAFT SUMMARY FINDINGS OF ADVISORY PANEL**

## Genetic Improvement of Farmed Tilapias - Phase II

### DRAFT SUMMARY FINDINGS OF ADVISORY PANEL 10 November, 1993

#### OVERVIEW

The Panel was extremely impressed with:

- the progress achieved to date.
- the technical quality of the research
- the high skill level of the staff
- the high level of cooperation among agencies

The project is effectively demonstrating:

- how NARS can be true research partners
- the application of modern animal breeding methodology to tropical aquaculture
- an excellent model of cooperation among international NGOs and NARS

The Project Leader is commended for his leadership and dedication in the development of equitable research collaboration. The Panel also commends the enthusiasm and dedication of the national staffs, and the commitment of the national government.

#### DETAILED COMMENTS

Detailed comments of the Panel deal primarily with the management and operation of the project, particularly what is seen as excessive expectation of GIFT and its project leader. Some comments also are offered on technical aspects of the strategic research section.

##### 1. Strategic Research Activities (Immediate Objective 1)

###### A. Selection Program

The panel finds that:

- the program is technically sound for the most part
- A complex system has been well implemented
- Accomplishments are significant

Comments on the technical aspects are:

Use of controls has not been consistent and effort has been excessive. A single unselected control, either repeat mating or standard strain, must be implemented each generation. Testing for farm performance should be done using separate protocols.

The project has not achieved true estimation of genetic response to selection due to lack of information on selection intensity. This should be corrected for the next generation so that realized genetic response can be estimated.

**B. On-Farm Trials**

These trials have been well executed and should be continued. Some technical problems have arisen but were outside the control of the project staff. The use of control populations should be re-evaluated as per comments on selection.

**C. Dissemination of Germplasm and Improved Breeds**

The Panel recognizes that dissemination of the 'GIFT' fish must be carried out but also finds that the project is not quite ready for the management of disseminated genetic material. Thus, caution and care are essential.

Three elements of concern are:

- Manual of procedures is not available.
- NARS do not have adequately trained staff
- Data on yield from field production trials are lacking.

In 1994, two of these concerns should be addressed. Procedure manuals must receive first priority. Yield data should be obtained from the on-farm trails to provide initial estimates of production performance. The training of staff will require a longer period and this issue is addressed by the Panel under the section on training.

**D. Philippine National Tilapia Breeding Program**

The organizational infrastructure is appropriate and well established. The potential for success is good within the concerns expressed under "C. Dissemination."

The immediate initiation of the country-wide program, as compared to a more moderate initiative will stress the PNTBP.

The Panel has some concern about how much input should be expected from the GIFT project even in the short term.

**E. Estimation of Economic Benefits of Improved Breeds**

The Panel has major concern about this aspect of the research. This objective is directed at the Luzon area of the Philippines. Part of its purpose is to support the GIFT research through providing data essential in defining the relative economic benefits of alternative genetic approaches to breed improvement. This is reasonable. Presumably, it also is directed at developing methodology for transfer to other areas and countries.

However, the study plan presented to the Panel was one to develop pre-release baseline data for the Philippines. It is to be based on the study of a minimum of 417 farms.

For GIFT project purposes, a smaller number of sites (20 to 40) should be identified for intense study involving controlled release of the improved breed. Post-release data should be collected for two years to provide initial estimates of economic impacts of switching to the improved breed.

This approach will aid in understanding the economic importance of various biological traits as well as the immediate effect of the use of an improved breed of tilapia on net farm production. Continuation of the study in parallel with the Philippine study over a longer time period will be necessary for evaluation of social impacts.

The Panel does not believe GIFT staff should have major responsibility for the general Philippine study.

**F. Cryopreservation of Tilapia Spermatozoa**

This is an important aspect of the GIFT project as a means of testing the rate of selection response as well as serving as a storage backup for the live germplasm collection.

The project must publish a catalog of the germplasm for distribution. There does not appear to be a defined strategy or protocols for the transfer of frozen material; this should also be included in the catalog of germplasm.

**G. Database Management**

This work group has excellent skills and has done a good job of applying existing technology in designing a sound database.

Capabilities in data analysis are less clear. The project staff have not developed sufficient technical knowledge or training in quantitative genetic theory to effectively utilize the database.

In addition, the project appears to require upgraded computer hardware to fully utilize the database. The capability of accessing the complete

data base also will be necessary for effective training of staff in advanced scientific and genetic skills.

## 2. New Traits (Immediate Objective 2)

The evaluation of additional biological traits is essential to an effective breeding program. However, care need be taken to distinguish between objectives relating to new traits for possible inclusion in the ongoing selection program on one hand, and objectives relating to possible new directions for breed development to accommodate genotype-environment interactions on the other hand.

The study of age-at-maturity should continue, with special emphasis on methods of measuring the trait that express a high level of genetic determination.

The study of tolerance traits (temperature, salinity, disease, etc.) should be directed at screening germplasm, not the current GIFT nucleus breed. If and when appropriate genetic material is identified, then a determination can be made regarding its transfer into the GIFT nucleus. In any case, it is likely that a new breed will be required for release to the specific environments.

## 3. Collection of New Germplasm (Immediate Objective 3)

Collection of new germplasm should continue on a selective basis.

GIFT should cooperate with NARS to obtain pre-screening of material before it is added to the ICLARM collection. The network (INGA) should be a focal point for this cooperation.

## 4. Training (Immediate Objective 4)

GIFT should accept responsibility for training at two levels: staff at partner institutions and staff at collaborating institutions. Training of farmers and hatchery managers should be the responsibility of NARS. GIFT should concentrate on training the trainers.

### A. Partner Institution Staff Training

The core staff at CLSU/FAC, BFAR, and GIFT have been well trained in skills and the procedures employed in current studies.

No systematic effort has been made to train the staff in basic quantitative genetic principles or the principles of the design, development and analysis of genetic studies.

The Panel underlines the need for a more systematic approach to scientific training for in-house staff.

GIFT should develop a specific course on genetic principles, estimation of quantitative genetic parameters, and the analysis of selection response. This should be done by contracting with an international expert(s) for the presentation of a course with a duration of about three months, possibly offered in two six-week modules. The course should be complete with teaching material, final examinations, and the awarding of diplomas for successful completion.

GIFT should organize short-term study tours at Advanced Scientific Institutions for interested staff.

Consideration should be given to developing an M.Sc. program with an animal breeding or plant breeding program at a Philippine institution, possibly, the University of the Philippines, Los Baños.

#### B. Training at Partner Institutions

In the absence of a specialized training unit within ICLARM and the urgent need for a more systematic training effort, the GIFT project training work-group should be strengthened by the addition of specialized consultants.

The consultants should plan and prepare training material in consultation with project technical staff. The training material should be directed at scientists and extension specialists. It should be appropriate for the Philippine effort, INGA activities, and for the purposes of the ADB project.

A special effort should be made to identify donor agencies who will sponsor overseas study for advanced degrees at institutions with a reputation for expert training in animal breeding.

### 5. International Network for Genetics in Aquaculture (Immediate Object 5)

The development of the network is a valuable undertaking and the Panel commends the project for the effort. However, the development of the network will require careful planning and strong administrative support. The Panel recommends that ICLARM incorporate the networking approach as a significant component of its germplasm enhancement thrust.

The GIFT project does not have the resources or the manpower to develop INGA. Sponsors requested the development of a network as part of GIFT but are not able to fund the activity. The minimum needs are a coordinator, a second quantitative geneticist, and funding for steering committee meetings, site tours, communications, and publications. These needs cannot be provided by the GIFT project as presently funded.

The Panel finds that the recruitment of a second quantitative geneticist is essential. This will provide the urgently needed additional man power for the genetics strategic research as well as technical support for INGA. Recruitment in this discipline will provide broader assistance than would be gained by hiring a population geneticist.

The Panel also recommends that UNDP provide minimum immediate funding to carry INGA through 1994. This funding should be sufficient to ensure a successful first meeting of the steering committee, extend the coordinator position through 1994, and provide ICLARM the opportunity to seek complementary funding for the network.

**Advisory Panel:**

Dr. Graham A.E. Gall  
Prof. Vo Tong Xuan  
Dr. Ziad Shehadeh



**GIFT PROJECT WORKING GROUPS MET BY  
THE ADVISORY PANEL MEMBERS ON 8 AND 9 NOVEMBER 1993  
IN NFFTRC/BFAR, MUNOZ, NUEVA ECIJA**

**A. GIFT PROJECT CORE STAFF**

**SELECTION AND BREEDING GROUP:**

Ruben Reyes	NFFTRC/BFAR
Marietta de Vera	ICLARM
Edna Dionisio	NFFTRC/BFAR
Lilibeth Afan	NFFTRC/BFAR
Hernando Bolivar	ICLARM

**BROODSTOCK/GERMPLASM/CRYOPRESERVATION MANAGEMENT  
GROUP:**

Jodecel Danting	NFFTRC/BFAR
Felicisima Longalong	NFFTRC/BFAR
Ruben Reyes	NFFTRC/BFAR

**ON-FARM TRIALS**

Hernando Bolivar	ICLARM
Ruben Reyes	NFFTRC/BFAR
Belen Acosta	ICLARM
Antonio Circa	FAC/GLSU

**DATABASE MANAGEMENT GROUP:**

Teresita Gonzales	NFFTRC/BFAR
Gracita Navidad	NFFTRC/BFAR
M.J. France Rius	ICLARM
Divino Rosales	ICLARM

**SOCIO-ECONOMIC GROUP:**

Gaspar Bimbao	ICLARM
Dr. Mahfuzuddin Ahmed	ICLARM
Belen Acosta	ICLARM

**STRATEGIC PLANNING/TRAINING:**

Dr. Ambekar E. Eknath

**B. PHILIPPINE NATIONAL TILAPIA BREEDING PROGRAM GROUP**

Ruben Sevilleja	FAC/CLSU
Ruben Reyes	NFFTRC/BFAR

**C. INTERNATIONAL NETWORK ON GENETICS IN AQUACULTURE**

Dr. D.V. Seshu	Coordinator
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**D. ICLARM:**

Dr. Roger S.V. Pullin  
Dr. Larry Stifel

MINUTES OF THE UNDP/DGIP  
TRIPARTITE REVIEW MEETING FOR THE PROJECT  
GENETIC IMPROVEMENT OF FARMED TILAPIAS PHASE II  
(GLO/90/016)

**MINUTES OF THE UNDP/DGIP TRIPARTITE REVIEW MEETING FOR THE  
PROJECT GENETIC IMPROVEMENT OF FARMED TILAPIAS  
PHASE II (GLO/90/016)**

Held at ICLARM HQ, Conference Room,  
Bloomingdale Bldg., Legaspi Village,  
Makati, Metro Manila  
10 November 1993, 3:00 p.m.

**1.0. The following participated in the meeting:**

**COLLABORATING INSTITUTIONS**

**ICLARM**

Dr. Laurence Stifel, Director General  
Dr. A.E. Eknath, Project Leader, Aquaculture Genetics  
Dr. Roger S.V. Pullin, Director, Inland Aquatic Resource Systems Program  
Mr. Basilio M. Rodriguez, Director, Management Services Division

**BFAR**

Mr. G. Morales, Director  
Mr. R. Reyes, Acting Project Manager

**FAC/CLSU**

Mr. R. Sevilleja, Director

**UNDP**

Mr. Abu Y.M. Selim, Deputy Resident Representative  
UNDP, Manila (Chairperson)

Mr. P. Reynolds, Senior Programme Officer, UNDP/DGIP (New York)

Ms. Chinwe Dike, Project Management Officer, UNDP/DGIP (New York)

Mr. Jorge Reyes, Senior Programme Manager, UNDP, Manila

**ADVISORY PANEL**

Dr. Graham Gall, Professor of Applied Genetics and  
Breeding, University of California at Davis, U.S.A

Dr. Ziad Shehadeh, Executive Coordinator  
Strategy for International Fisheries Research  
IDRC, Ottawa, Canada

## **INVITED OBSERVERS**

### **PHILIPPINES**

**Dr. Rafael Guerrero, Executive Director  
Philippine Council for Aquatic and Marine Research  
and Development (PCAMRD)**

### **ADB**

**Mr. Weidong Zhou  
Fisheries Specialist**

**2.0. The following documents were used as background materials for the meeting:**

- a. GIFT Project (Phase II) Progress Report (July 1992 to October 1993)
- b. Draft Summary Findings of Advisory Panel for GIFT Phase II
- c. Summary of Agreements of the Second Tripartite Review Meeting of GIFT Phase I held in May 1992
- d. GIFT Phase I Revised Workplan of Project Activities for Year I and Draft Plan of Activities for Year II
- e. Agenda and List of Participants - First UNDP Tripartite Review for GIFT Phase II
- f. Towards Sustainable Food Security - Speech of Mr. Gus Speth (UNDP Administrator) in the Forum Organized by CGIAR, Washington, D.C., 25 October 1993

**3.0. Chairperson's Opening Remarks**

Mr. Selim welcomed the participants of the First Tripartite Review Meeting of the GIFT Phase II. He briefed everyone on the purpose, format and focus of the meeting to facilitate the discussions.

He also explained the relevance of GIFT Phase II in the context of UNDP's role in development cooperation. In particular, he shared Mr. Speth's message delivered in a forum held in Washington, DC in October 1993. The message, which articulated Mr. Speth's vision of sustainability, was that development should be people centred, environmentally sound, participatory, and it should build local and national capacity for self-reliance.

Against this background, Mr. Selim reminded that the following should be properly addressed in the GIFT Phase II:

- i) national capacity building for creating self-reliance;

- ii) people centred development (people must be the ultimate beneficiary of development);
- iii) participatory approach to development (participation by government and non-government organizations, private sector, women and other groups);
- iv) environmentally sound and sustainable development (conservation of biodiversity and maintaining ecological balance);
- v) optimum utilization of available resources (efforts towards greater resource mobilization nationally, regionally and internationally) and;
- vi) sustainability of the project results and its continuation after completion of UNDP collaboration.

#### 4.0. Opening Remarks

- 4.1. Mr. Reynolds mentioned that the GIFT Project Phase II began in January 1993 and the results obtained so far have been impressive. He added that UNDP and all the scientists who worked for the project were honored by the Philippine President's recent launching of the National Tilapia Breeding Program. He noted, however, that this event also brings forth additional responsibilities to the project team which the Tripartite Review participants should take into account. He also highlighted the importance of the Advisory Panel for the review of the project.
- 4.2. Dr. Stifel expressed gratitude to UNDP for its continuous support to GIFT Project. He mentioned that the project was recognized as a significant breakthrough during the CGIAR meeting held in Washington in October 1993. ICLARM realized however that the success only represents a milestone in a long research effort and that complex and difficult problems lie ahead. He added that ICLARM was extremely pleased that the external Advisory Panel has been constituted.

#### 5.0. ICLARM within CGIAR

Dr. Stifel mentioned that ICLARM has been admitted into the CGIAR as the 18th Center. ICLARM has now embarked on a process of transforming itself from a project-driven to an integrated program-oriented Center. He reported that this takes place during a period of significant decline in the overall funding of CGIAR. But despite the budget stringency in CGIAR, donors have assured ICLARM of sustained support to its core programs. One of the important thrusts of the IARSP focuses on the genetic improvement of fish breeds. Dr. Stifel expressed optimism that donors will continue and increase their support to ICLARM because of its innovative work in the management of resources.

## 6.0. GIFT Project

### 6.1. Video Presentation

Dr. Stifel briefed the group on the circumstances in which the video on GIFT Project was prepared for the CGIAR meeting held in Washington in October 1993 and how this presentation was well received by the participants.

Following Dr. Stifel's brief introduction, the group viewed the GIFT Project video as told by ICLARM petfish, 'Onee'.

### 6.2. GIFT Phase II - Progress of Activities

#### 6.2.1. Immediate Objectives 1 to 4

Dr. Eknath enumerated the immediate objectives of the project. These cover: 1) selection and dissemination of improved breeds; 2) investigation of the genetics of economically important traits leading to efficient selection programs; 3) documentation and collection of promising traits for evaluation and possible inclusion in the on-going selection program and building up of base populations; 4) strengthening of capacity of national institutions to carry out selection work and develop national fish breeding programs; and 5) development of an international network for genetics in aquaculture (INGA).

He discussed in detail the outputs and activities in relation to the first four objectives. He explained that:

- the response to selection based on the growth performance of the progeny of the control (average performing breeders) and the progeny of the selected breeders in FAC and BFAR ponds was about 14%. When measured on the same units as the first generation selection, this 14% would be equal to about 17% in growth performance.
- the on-farm trial has been a major effort in the project. Preliminary analysis of the data from Magat and Pantabangan cages indicated that the GIFT fish grew 50-60 % faster than the commercial tilapia strain.
- concerning the growth performance of improved breeds in the rice paddies, the growth of the founder stock ('Senegal' strain) was comparable to the 'GIFT' and commercial strains.
- the efforts during the first year of the genetic variation for age at first spawning experiment were mainly devoted to seeing how best this trait can be recorded. The experiments for the investigation of the other two important traits (cold and brackishwater tolerance) will be

repeated due to very low survival rate obtained during harvesting.

- in October 1992, the new germplasm were collected from Egypt to investigate the specific traits such as cold and brackishwater tolerance.
- the project's socio-economic study on tilapia has been started. The strategy would be to determine the effect of the improved breed at farm level and to examine the magnitude of the economic benefits.

#### 6.2.2. Philippine National Tilapia Breeding Program

Mr. Sevilleja described the objectives and structure of the Philippine National Tilapia Breeding Program. He mentioned that the initial activity of this program will be the production and dissemination of the GIFT fish.

#### 6.2.3. International Network on Genetics in Aquaculture (INGA)

Dr. Seshu briefed the group on the accomplishments of the UNDP mission which led to the formation of INGA. The network would be governed by the national programs and it would neither be donor nor ICLARM driven. The national programs have already been requested to submit their research plans for the first year. The network's steering committee is scheduled to meet in May 1994.

### 7.0. Advisory Panel Findings and Discussions

Dr. Gall, in behalf of the Advisory team, thanked everyone for their cooperation which enabled the Panel members to accomplish their task easily.

He reported on the results of Panel review on GIFT Project Phase II, covering the period July 1992 to October 1993. Overall, the Panel was impressed with the progress achieved to date, the technical quality of research, the high skill level of the staff and the high level of cooperation. They also commended the project leader for his leadership and the national staff, for their dedication and commitment. Although the Panel had found much to commend, they also indicated some weak points that needed to be strengthened.

Issues highlighted in the report and discussions included the following:

#### 7.1. Project Management

Concern was expressed about the excessive expectations from the GIFT Project. The project team was reminded that notwithstanding the dedication and enthusiasm of staff, too heavy a workload can only be sustained for a short period of time.

## 7.2. Publications and Training

These should be given top priority in 1994 workplan. The project team was reminded that the scientific achievement of the project can only be validated if the results have been peer-reviewed and accepted by the scientific community.

The project was also asked to prepare the manual of procedures which will document the techniques/methodologies developed in the GIFT. It was agreed that the project will give first priority to the preparation of the manual.

Dr. Eknath agreed with the Panel's comment concerning publications. He also recognized the immediate need for an intensive training of GIFT core staff on quantitative genetics to enable them to participate more actively in writing scientific papers. He added that the project plan of action in the first quarter of 1994 will include contracting international experts for an intensive course in quantitative genetics.

Apart from the short-term training, Dr. Guerrero recommended that the national program staff of GIFT Project pursue graduate studies (MS or PhD) in either Central Luzon State University or University of the Philippines at Los Baños. This was stressed as very important in enhancing their research capacity.

## 7.3. Strategic Research (based on the objectives outlined in the July 1992-93 Progress Report).

### 7.3.1. Selection Program

The panel found that the selection program had been well implemented and the accomplishments significant. However, the use of controls had not been consistent and that there might have been too much effort on the use of controls vis-a-vis available resources. Another observation was that the project has not yet achieved a true estimate of genetic response due to lack of information on selection intensity. This should be corrected in the next generation in order to estimate the realized response to selection.

### 7.3.2. On-Farm Trial

The on-farm experiment has been well executed and needs to be continued. The use of controls should be reevaluated as per comments on selection.

### 7.3.3. Cryopreservation of Tilapia Spermatozoa

This has been executed excellently. The Panel was convinced of the importance of this aspect of the Project and recommended its continuation. The Panel suggested that a catalog of the germplasm for distribution be published.



#### 7.3.4. New Traits

The Panel recommended that the study of age at maturity be continued, with special emphasis on methods at measuring the trait that express high level of genetic determination. It was also suggested that investigation for other new traits (temperature, salinity, disease) be directed at screening germplasm and not the current GIFT nucleus breed.

#### 7.3.5. Collection of New Germplasm

This activity was recommended for continuation on a selective basis. The project was encouraged to cooperate with NARS through the INGA to obtain pre-screening of material before its inclusion in the germplasm collection.

#### 7.4. Database Management

The Panel commended the project's database group for their skills in designing a sound database. The panel also recognized the need for: 1) the upgraded hardware to fully utilize the database and; 2) the capability of staff in accessing the complete database as this will be necessary for effective training of staff in advanced scientific and genetic skills.

#### 7.5. Dissemination of Improved Tilapia Breed

The Panel found the project not ready yet for dissemination because: i) the manual of procedure is not available; ii) NARS do not have adequately trained staff and; iii) data on yield from field production trials are still lacking. Although there were indications that the improved breed grows faster than commercial strains in field trials, the data to support this were still inadequate.

Mr. Morales expressed concern that the improved tilapia breed has already gained the interest of Philippine national leaders which has created pressure on BFAR to make the improved tilapia breed available as soon as possible.

Dr. Shehadeh clarified the issue on dissemination. The need to disseminate the improved tilapia was recognized but this should be carried out with caution. He also suggested BFAR to conduct, with strict supervision, their own field trials prior to dissemination.

Dr. Eknath assured the panel that the project has already planned for the above strategy. ICLARM and BAS will soon conduct a well supervised dissemination process which will include a thorough assessment of the the pre- and post distribution impact of improved tilapia breed.

Ms. Dike raised an important issue on how will the project bring the results and improved breed to the farmers/endusers?

Mr. Selim took note of the concern expressed by Ms. Dike. GIFT, being an interregional project it would be important to know how the results will reach the poor farmers at the national level. Networking was considered the best possible way to accomplish this task.

The new INGA has already received numerous requests for an improved tilapia breed. Dr. Eknath said the strategy which the INGA has planned is to disseminate fish through the nodal centers in each country. These national research institutions will first evaluate the performance of the improved genetic material along with their existing fish.

#### 7.6. Philippine National Tilapia Breeding Program (PNTBP)

The Panel considered the PNTBP structure appropriate and well organized but expressed concern about how much input should be expected from the GIFT Project even in the short term.

#### 7.7. Estimation of economic benefit of improved breeds

The Panel suggested that the economic importance of other biological traits apart from growth be evaluated.

#### 7.8. International Network on Genetics in Aquaculture (INGA)

There was extensive discussion on the hiring of another quantitative geneticist who will be reporting to INGA Steering Committee. The Panel pointed out that ICLARM can proceed with the networking but would certainly need additional human resources.

Dr. Pullin commented that availability of well trained geneticists in some national programs constitutes one of the strengths of INGA and certainly none of the INGA member country completely lacks of scientific expertise in genetics. For example, there were highly trained geneticists in China, India, Vietnam and Thailand. Moreover, the research facilities in some of these member countries were very extensive. Thailand, for example is building up a large Aquaculture Genetics Research Institute.

Concerning funding for INGA, Mr. Reynolds mentioned that Dr. Seshu has already identified what it would need for 1994 and this was crucial for the network. He added that UNDP can provide US\$ 130,000 for the minimum initial requirements of the INGA. The GIFT Project could provide half of the amount and DGIP would provide the other half. He also reaffirmed UNDP's commitment to support the INGA as much as possible.

Dr. Shehadeh commented that the formation of INGA has opened up new opportunities for funding the national programs. Funding can best be sought if the INGA were considered outside ICLARM's core activities. This was appropriate because ICLARM participates only as a member of the network and does not decide the research priorities of members. However, ICLARM would be in charge of coordination and finding the money to fund the network meetings and training. This

approach would also help secure funding through the SIFR and bilateral channels. The bilateral agencies work directly with the national institutions thus the national institutes could seek bilateral support. Dr. Shehadeh assured the group of the SIFR's assistance in this regard.

Mr. Selim appreciated the help offered by Dr. Shehadeh to INGA. He hoped that other donors would also support the national programs' initiatives. Mr. Selim suggested that perhaps during the next INGA meeting in May 1994, support from members' in-country UNDP offices could be explored.

#### 7.9. Fund Sourcing

Commenting on the financial and administrative issues, Mr. Rodriguez cautioned that while both UNDP and ADB will be providing 'seed money', the project's resources might be put under extreme strain in the coming years because of the competing demands for these funds in many activities of the project. Thus, he suggested that efforts should be made also by the national programs to search for bilateral support.

Mr. Reynolds agreed that additional resources are needed to make the project succeed. He mentioned that this should be seen in the context of identifying the immediate needs in the project.

Mr. Zhou added that ADB was considering for funding a proposal submitted by ICLARM on a 'Regional Technical Assistance for Dissemination and Evaluation of Genetically Improved Tilapia Species in Asia'. This will complement what UNDP will provide to the GIFT Project. However, because of the Bank's limited resources the study will only concentrate on 5 selected countries, which are already members of the INGA.

#### 7.10. Workplan

It was agreed that the GIFT Project team will submit, as soon as possible, the 1994 workplan and their systematic response to the final version of the Advisory Panel Report. The project workplan for the period January-December 1994 will take into account various comments and suggestions by the Review Panel. Sharper focus will be on the management of research, training, dissemination of improved genetic material, networking and national breeding program. It will also include the budget, allocation of resources and activity time table.

### 8.0. Concluding Statements

- 8.1. Noting the divergent views expressed concerning the dissemination of improved tilapia breeds, Ms. Dike reminded that a unified strategy and vision was needed to achieve the purpose of the project. She pointed out the importance of maintaining a balance in both science and development pursuits. She also stressed the need to prioritize the project activities appropriately to avoid overload.

- 8.2. Dr. Stifel mentioned that the success of the project was not only something that everyone should be proud of but should also make one realize that it has opened up new challenges particularly those that the Advisory Panel had raised. He added that Ms. Dike's comments on balance were very important and that he was particularly encouraged by UNDP's reaffirmation of support to continue the INGA.
- 8.3. In behalf of UNDP, Mr. P. Reynolds commended the Review Panel for a job well done, for their interest, commitment and for their willingness to listen to the GIFT staff. He mentioned that the contributions of the Panel have given the UNDP and the project a solid basis on where to lay the groundwork for GIFT Phase II. He also thanked the ADB for joining hands with UNDP, and the project team, for their fine performance in the project.
- 8.4. In his closing remarks, Mr. Selim expressed gratitude for the opportunity given him to chair the review meeting. He also commended the important contributions made by the Advisory Panel, particularly in helping the project team examine the overall concept of GIFT Phase II and assess its objectives in relation to the new workplan that will be prepared.

He also urged everyone not to lose sight of the vision of sustainable human development. He mentioned that perhaps a concept paper can be developed in relation to the workplan. Finally, he thanked everyone on the table for their active participation.

## 9.0. Summary of Conclusions and Agreements

The meeting:

- 9.1. commended the technical quality of the GIFT research, the high skill level of staff, the high level of cooperation and the progress achieved by the project to date.
- 9.2. noted the excessive expectations from the GIFT project and agreed that this concern will be addressed properly.
- 9.3. noted the need to prioritize appropriately the project activities to avoid overload; agreed that there should be a balance in both development and scientific pursuits in order to achieve the objectives properly.
- 9.4. noted that the production of publications constitute a major weak point in the GIFT project and agreed that this will be given top priority in 1994.
- 9.5. noted the need to distribute the improved tilapia breed; however agreed that this should be carried out cautiously.
- 9.6. noted that the project is not ready yet with dissemination because the manual of procedure is not available, NARS do not have adequately trained staff, and supporting data on yield from field production trials are still lacking.

- 9.7. recommended immediate intensive training of GIFT core staff on quantitative genetics and agreed that this will be accomplished in the first quarter of 1994; further recommended long-term training (MS and PhD) in either CLSU or UPLB for national program staff.
- 9.8. noted that aside from growth rate, there is a need to investigate the economic importance of other biological traits.
- 9.9. agreed that dissemination of tilapia to national programs and fish farmers will be carried out through INGA.
- 9.10. recommended that efforts should also be made to seek bilateral support for the increasing number of activities in the GIFT Project.
- 9.11. agreed that UNDP will consider providing US\$ 130,000 for the initial minimum requirement of INGA (half of the amount could be provided by GIFT Project and another half by DGIP); also noted that Dr. Shehadeh, in his capacity as Executive Secretary of SIFR, has pledged to help secure support to the INGA.
- 9.12. agreed that the GIFT Project team will submit as soon as possible their 1994 revised workplan and the response to the final version of the Advisory Panel report; agreed that the revised workplan will take into consideration what the panel has recommended and shall include budget and activity time table.

**LIST OF ACRONYMS**

<b>ADB</b>	- Asian Development Bank
<b>BFAR</b>	- Bureau of Fisheries and Aquatic Resources
<b>CGIAR</b>	- Consultative Group of International Agriculture Research
<b>DGIP</b>	- Division of Global and Interregional Programme
<b>FAC/CLSU</b>	- Freshwater Aquaculture Center/Central Luzon State University
<b>GIFT</b>	- Genetic Improvement of Farmed Tilapias
<b>IARSP</b>	- Inland Aquatic Resource Systems Program
<b>ICLARM</b>	- International Center for Living Aquatic Resources Management
<b>INGA</b>	- International Network on Genetics in Aquaculture
<b>NARS</b>	- National Agricultural (Aquaculture) Research System
<b>SIFR</b>	- Study on International Fisheries Research
<b>TPR</b>	- Tripartite Review

COMMENTS TO THE DRAFT SUMMARY FINDINGS OF THE  
EXTERNAL ADVISORY PANEL (10 NOV. 1993)  
AND  
TO THE DRAFT RESPONSE  
FROM THE GIFT TEAM (25 NOV. 1993)  
FROM  
HANS B. BENTSEN AND TRYGVE GJEDREM  
AKVAFORSK

December 13, 1993

**COMMENTS TO THE DRAFT SUMMARY FINDINGS  
OF THE EXTERNAL ADVISORY PANEL (10 NOV. 1993)  
AND  
TO THE DRAFT RESPONSE  
FROM THE GIFT TEAM (25 NOV. 1993)  
FROM  
HANS B. BENTSEN AND TRYGVE GJEDREM  
AKVAFORSK**

**General Comments:**

We have discussed the two documents and are pleased that an External Advisory Panel (EAP) has been established and is in action. We also agree that the findings of the EAP provide valuable input in the further work with the GIFT project, and we support the conclusions of the Draft Response. Our further comments to some of the detailed findings and recommendations follows below. However, we are somewhat confused by the fact that the EAP has neither evaluated AKVAFORSK's participation in the GIFT project nor collected input from involved AKVAFORSK staff members. AKVAFORSK does not have a lot of experience with this type of international projects, and will need all the feedback we can get. As the Draft Summary Findings stands now (eg. Chapters 1.G, second paragraph, and 4.A and 4.B), AKVAFORSK does almost not seem to be considered as a project partner. The Draft Response does not give any reaction to this, but seems to accept the idea that the project will have to seek advanced scientific support outside the present project team. Invited or contracted experts may certainly be able to improve the output of the project, but we feel that the first option should be to find ways to utilize better the expertise already involved in the project. We have already (eg. during our visit



to Manila in May 1992) launched the idea that AKVAFORSK may start putting together an international course in quantitative genetics applied to fish breeding, and we made a first attempt to start the training of the project staff in quantitative genetics already in 1989 during the initial workshop in Norway. We are well aware that we all have a lot of ground to cover before we can offer an adapted training package, but considering our many years of joint experience in the GIFT project, it seems like a waste of time and experience if we don't explore the capacity of the GIFT partners to handle this challenge. Any suggestions from the EAP (or from within the GIFT staff) about how this may be achieved should be welcomed.

Furthermore, we were not informed about the EAP meeting (or the Tripartite Review) in November. Even if our presence at such occasions is not very likely, we will appreciate to receive an invitation, if possible well in advance. This will make it possible for us to consider our needs and possibilities to participate.

**Detailed Comments:**

Referring to the layout of the EAP Draft Summary Findings.

**1.A and 1.B:**

The topic of appropriate *controls* is important. Previous experience with maintaining a genetically stable control population indicates that this will require a lot of research resources and work that may be better utilized to achieve genetic progress and avoid inbreeding in the selected population. Even if the proper resources are allocated, control populations with a short history in the experimental environment may be severely affected by natural selection. The best short term solution is probably to reproduce a number of breeders with average breeding values in each generation, and to repeat those matings in the first following generations if the breeders may be kept alive. This will require some studies on the effect of the age of the dams on the performance of the offspring. The long term control will probably be best taken care of by using frozen milt from sire breeders tested in previous generations (preferably average

breeders previously used to produce short term controls).

The definition of proper controls in on-farm trial is less obvious. The important thing for the farmer is the performance of the GIFT fish relative to whatever material he or she would have used if the GIFT fish was not available. The superiority of the GIFT fish may consequently be highly variable from one farm to another, depending on the alternative source of fingerlings. If so, this will only reflect the real life situation, and that is what we want to test in the on-farm trials. The main problem will then be to ensure that the fingerlings from the two genetic groups have been given the same treatment until stocking.

The EAP requests information about the *selection intensity* so that realized genetic response can be estimated. This must be a misunderstanding. The realized response can only be estimated by including proper controls. This may then be compared with the expected response. Under mass selection, the expected response may be predicted from the selection intensity and the heritability of the trait. If the selection is based on breeding value estimates obtained from a selection index, as in the GIFT project, the procedure is less straightforward. The selection intensity on the scale of index breeding values may easily be computed, and the expected response may theoretically be predicted using the average accuracy of the breeding value estimates of the selected breeders (an equivalent to the heritability concept in this situation), as long as the breeding goal is one trait only.

**1.G:**

Hopefully, the statement in the second paragraph does not include the AKVAFORSK staff (or the project leader). See under General Comments above.

**4.A and 4.B:**

As pointed out under General Comments above, the statement in the second paragraph of Chapter 4.A is not entirely true. An initial training workshop in quantitative genetics was arranged in Norway in 1989. However, since most of

the GIFT staff members at that time have left the project, and since most of the following workshops have been jammed with practical applications of the theory to satisfy the needs for rapid results, the EAP conclusion is understandable.

The suggested solutions to the problem, as indicated in the last three paragraphs of Chapter 4.A and the two first paragraphs of Chapter 4.B, seems to imply allocation or reallocation of funding for training purposes in addition to the ordinary budget for the project leader and AKVAFORSK. If so, we feel that the prospects of covering some of the needs for training by increasing the engagement of the project partners (including AKVAFORSK) should be considered. This does not necessarily exclude the need to contract international experts outside the project staff, but may facilitate the integration of the training component with the experience and background of the Philippine GIFT staff.

As stated under General Comments above, the GIFT project should also consider the best way to utilize AKVAFORSK's regular engagement, in particular if less practical assistance is needed during the routine computer sessions.

**FINDINGS OF THE ADVISORY PANEL**

**Genetic Improvement of Farmed Tilapias**

**Phase II - Project GLO/90/016**

December 1993

# **FINDINGS OF THE ADVISORY PANEL**

## **Genetic Improvement of Farmed Tilapias**

**Phase II — Project GLO/90/016**

**Prepared for  
United Nations Development Programme  
Division for Global and Interregional Programmes**

**December 1993**

# Genetic Improvement of Farmed Tilapias

Phase II — Project GLO/90/016

## FINDINGS OF THE ADVISORY PANEL

### THE REVIEW

A review of Phase II of the Genetic Improvement of Farmed Tilapias (GIFT) project was carried out on 8-10 November, 1993 at the request of the United Nations Development Programme's Division for Global and Interregional Programmes (UNDP/DGIP). The project is a collaborative effort implemented by the International Center for Living Aquatic Resources Management (ICLARM), Manila, Philippines in cooperation with the Freshwater Aquaculture Center - Central Luzon State University (FAC/CLSU), the Philippines National Freshwater Fisheries Technology Research Center - Bureau of Fisheries and Aquatic Resources (NFFTRC/BFAR) both at Muñoz, Nueva Ecija, Philippines, the University of the Philippines - Marine Science Institute (UPMSI), Diliman, Quezon City, Philippines, and the Institute of Aquacultural Research (AKVAFORSK), Ås, Norway.

The terms of reference for the Advisory Panel (panel) review were outlined in a letter of 6 January, 1993 from Timothy S. Rothermel, Director of UNDP/DGIP. In his letter, Mr. Rothermel requested the panel to review:

*"the quality, focus and progress of the research and training components; issues relating to germplasm development; environmental and social impacts; networking; and other appropriate issues which may arise."*

The panel also outlined some specific questions to be addressed during the review including, but not limited to: Is the scientific basis for the germplasm improvement program sound? Is management of the project effective? Is the work group organization of core staff a good arrangement? To what extent can the project team carry out the tasks of the project without outside guidance and consultation? What are the prospects for the Philippine National Tilapia Breeding Program to achieving self-sufficiency? Is the 1994 program of work sound, are tasks properly prioritized, and is likelihood of successful completion high?

The panel's activities while in Manila were facilitated through discussions by the panel chair and panel members, with Mr. Phil Reynolds, Senior Programme Officer, UNDP/DGIP. The terms of reference were clarified and the method and schedule for the review were finalized. The panel also discussed the general goals of the UNDP/DGIP effort and the schedule and format for the panel's draft and final reports.

## METHOD OF REVIEW

Three members of the Advisory Panel (Dr. Graham A.E. Gall, Professor Vo Tong Xuan and Dr. Ziad Shehadeh: see Appendix I for a full listing of the Advisory Panel Membership) assembled in Manila, Philippines on 7 November 1993. The panel examined the project site, interviewed the core project staff, and held discussions with the project leader. In addition, the panel met with members of the ICLARM management staff, the leaders of the Philippine National Tilapia Breeding Program (PNTBP), and the coordinator of the International Network on Genetics in Aquaculture (INGA). PNTBP is the first national fish breeding program initiated by the GIFT project and currently receives technical and scientific support from the project. INGA is a network of eleven African and Asian countries initiated by the GIFT project and designed to coordinate the development of national breeding programs and facilitate the exchange of germplasm for the member countries. The international network currently receives financial, technical and scientific support from the GIFT project.

The panel undertook a systematic review of the project through visits to the project site and interviews with persons directly involved with GIFT project activities and management. On 8 November, the panel traveled to FAC/CLSU and NFFTRC/BFAR at Muñoz, Nueva Ecija to visit the project site. On arrival, the project staff gave the panel an excellent overview of the project and a review of work accomplished. The panel then visited a number of activities at the project site and was given demonstrations of a number of the technologies employed by the project, including the reference tank system, the quarantine system, the breeding methods, sampling and tagging of fish, packing and transporting of fish, the cryopreservation of sperm and the data management system. During the afternoon of 8 November, the panel interviewed the core staff in small work groups and discussed the PNTBP with the program leaders. The staff interviewed and their work group affiliations are listed in Appendix II.

In Manila on 9 November, the panel held discussions with the Director General of ICLARM, Dr. Larry Stifel, and the Director of the ICLARM Inland Aquatic Resources Systems Program, Dr. Roger Pullin. In addition, discussions were held with the GIFT Project Leader, Dr. Ambakar Eknath, and the Coordinator of INGA, Dr. D.V. Seshu. For the remainder of 9 November and much of 10 November, the panel reviewed documents pertaining to project development, progress reports, development of the international network, and publications resulting from project research, held private discussions on the site visits and interviews with project and management staff, and prepared a draft report. A list of documentation reviewed by the panel is given in Appendix III.

On November 10, the two members of the panel (Dr. Gall and Dr. Shehadeh) participated in a UNDP/DGIP Tripartite Review of the GIFT project. The panel provided a draft summary report of its findings (see Appendix IV), presented an oral report of its findings, and participated in discussions of project accomplishment and the 1994 work plan for the project.

## OVERVIEW OF THE PROJECT

The panel was extremely impressed with the progress achieved to date, the technical quality of the research, the high skill level and dedication of the staff, and the high level of cooperation among agencies.

The project is effectively demonstrating how national aquaculture research services (NARS) can be true research partners and the application of modern animal breeding methodology to tropical aquaculture. It is an excellent model of cooperation between international nongovernmental organizations (NGOs) and NARS.

The Project Leader is commended for his leadership and dedication in the development of equitable research collaboration. The panel also commends the enthusiasm and dedication of the national staff, and the commitment of the national government.

## DETAILED COMMENTS

Detailed comments of the Panel deal primarily with the management and operation of the project, particularly what is seen as excessive expectations of GIFT and its project leader. Some comments also are offered on technical aspects of the strategic research element. The detailed comments are presented for each Project Objective as outlined in the GIFT Phase II Progress Report, July 1992 to October 1993 dated November 1993

### 1. Strategic Research Activities (Immediate Objective 1)

#### A. Selection Program

The panel finds that the program is technically sound for the most part. A complex system has been well implemented, and accomplishments have been significant.

Two technical comments are offered on the technical aspects of the project. The use of controls has not been consistent and effort in maintaining control groups for genetic evaluations has been excessive. A single unselected control, either repeat mating or standard strain, must be implemented each generation. In this regard, studies to test on-farm performance should be done using protocols separate from those designed for genetic evaluation of improved germplasm.

The second comment is related to the use of controls but concerns estimation procedures. The project has not achieved true estimation of genetic response to selection due to lack of



information on selection intensity. This should be corrected for the next generation so that realized genetic response can be estimated. The alternative approach of relying entirely on changes in mean breeding value over generations may be effective in estimating genetic progress but will not serve the need to demonstrate actual phenotypic improvement achieved by nation breeding programs.

## B. On-Farm Trials

The on-farm trials have been well executed and should be continued. Some technical problems have arisen but were outside the control of the project staff. The use of control populations should be re-evaluated as per comments on selection.

## C. Dissemination of Germplasm and Improved Breeds

The Panel recognizes that dissemination of the 'GIFT' fish must be carried out but also finds that the project is not quite ready for the management of disseminated genetic material. Thus, caution and care are essential as the project initiates the PNTBP.

The panel is concerned about:

- The absence of a manual of procedures.
- The inadequate training of NARS staff.
- The lack of data on yield from field production trials.

Two of these concerns should be addressed in the 1994 work plan. Procedure manuals should receive first priority. Yield data should be obtained from the on-farm trails to provide initial estimates of production performance. The training of staff will require a longer period and this issue is addressed by the panel under the section on training.

## D. Philippine National Tilapia Breeding Program

The organizational infrastructure is appropriate and well established. The potential for success is good within the concerns expressed under section C. "Dissemination.

The immediate initiation of the country-wide program, as compared to a more modest initiative, will stress the PNTBP and force the GIFT project to provide continuing scientific and technical support. Thus, the panel has some concern about how much input should be expected from the GIFT project even in the short term.

## E. Estimation of Economic Benefits of Improved Breeds

The panel has major concern about this aspect of the research. This objective of the GIFT project is directed at the Luzon area of the Philippines. Part of its purpose is to support GIFT project research through providing data essential in defining the relative economic benefits of alternative genetic approaches to breed improvement. This is reasonable. Presumably, this objective also is directed at developing methodology for transfer to other areas and countries.

However, the stated objective of the study plan presented to the panel is to develop pre-release baseline data for the Philippines, based on the study of at least 417 farms. The panel was subsequently advised of an ICLARM proposal, to be funded by the Asian Development Bank (ADB), to extend the socio-economic study to a number of Asian countries. This appears to be appropriate.

For purposes of the GIFT project, a Philippine study with a smaller number of sites (20 to 40) than planned (417) should be identified for intensive study involving controlled release of the improved breed (GIFT Fish). Post-release data should be collected for two years to provide initial estimates of economic impacts of switching to the improved breed.

This approach will aid in understanding the economic importance of various biological traits as well as the immediate effect of the use of an improved breed of tilapia on net farm production. Continuation of the study in parallel with the Philippine study over a longer time period will be necessary for evaluation of social impacts.

The panel does not believe the GIFT project staff should have major responsibility for the general Philippine study and care must be taken not to burden the GIFT project with the proposed ADB project without the addition of new staff. A more appropriate arrangement may be to implement the ADB project through the newly established international network (INGA).

## F. Cryopreservation of Tilapia Spermatozoa

The cryopreservation of sperm is an important aspect of the GIFT project. It provides a means of evaluating selection response over generations through repeat matings of males to produce progeny in later generations. It also provides an economical means of storing a backup supply of genetic material from the live germplasm collection for improved security.

The project must publish a catalog of the germplasm for distribution to interested countries. It also must devise a strategy or protocols for the transfer of frozen material and include this information in the catalog of germplasm.

## G. Database Management

The database work-group has excellent skills and has done a good job of applying existing technology in designing a sound database for the storage and retrieval of data from GIFT project research.

Capabilities of the work group in the area of data analysis are less clear. The project staff do not appear to have had adequate training, or developed sufficient technical knowledge, in quantitative genetic theory to effectively utilize the database.

In addition, the project appears to require upgraded computer hardware to fully utilize the database. Hardware capable of accessing the complete data base also will be necessary for effective training of staff in advanced scientific and genetic skills.

### 2. New Traits (Immediate Objective 2)

The evaluation of additional biological traits is essential to an effective breeding program. However, care need be taken to distinguish between objectives relating to new traits for possible inclusion in the ongoing selection program on one hand, and objectives relating to possible new directions for breed development to accommodate genotype-environment interactions on the other hand.

The study of age-at-maturity should continue, with special emphasis on methods of measuring the trait that express a high level of genetic determination. This trait is an example of one that may be desirable in a future multitrait selection scheme.

The study of tolerance traits (temperature, salinity, disease, etc.) should be directed at screening germplasm, not at evaluations of the current GIFT nucleus breed under selection for improved growth. A determination regarding the transfer of new material into the GIFT nucleus can be made when and if appropriate genetic material is identified.

It is likely that a new breed will be required for release to the specific environments. A decision on whether to initiate such a new breed from the current GIFT nucleus or to form a new breed strictly from new germplasm should be delayed until the germplasm is identified. Project plans must take into account the likely necessity of new breeds for specific environments and that such an effort will greatly increase the resource requirement of the project.

### **3. Collection of New Germplasm (Immediate Objective 3)**

Collection of new germplasm should continue on a selective basis for specific breeding purposes, and initiated only after promising germplasm is identified through pre-screening in the source country.

The GIFT project should cooperate with NARS to obtain pre-screening of material before it is added to the ICLARM collection. The network (INGA) should be a focal point for this cooperation.

### **4. Training (Immediate Objective 4)**

The GIFT project should accept responsibility for training at two levels: staff at partner institutions and staff at collaborating institutions. Training of farmers and hatchery managers should be the responsibility of NARS. The panel recommends that the GIFT project concentrate on training the trainers.

#### **A. Partner Institution Staff Training**

The core staff at CLSU/FAC, BFAR and ICLARM directly working on GIFT project research have been well trained in the skills and the procedures employed in current studies.

However, it was evident that no systematic effort had been made to train the staff in basic quantitative genetic principles or the principles of the design, development and analysis of genetic studies.

The panel underlines the need for a more systematic approach to scientific training for in-house staff.

The GIFT project should develop a specific course on genetic principles, estimation of quantitative genetic parameters, the genetic basis of selection programmes, and the analysis of selection response. This should be done by contracting with an international expert(s) for the presentation of a course with a duration of about three months, possibly offered in two six-week modules. The course should be complete with teaching material, final examinations, and the awarding of diplomas for successful completion.

The GIFT project should organize short-term study tours at Advanced Scientific Institutions for interested staff.

Consideration should be given to developing an M.Sc. program with an animal breeding or plant breeding program at a Philippine institution, possibly with the University of the Philippines, Los Baños.

## **B. Training at Partner Institutions**

In the absence of a specialized training unit within ICLARM and the urgent need for a more systematic training effort, the GIFT project training work-group should be strengthened by the addition of specialized consultants.

The consultants should plan and prepare training materials in consultation with project technical staff, INGA and participating member institutions. The training materials should be directed at scientists and extension specialists. It should be appropriate for the Philippine effort, INGA activities, and for the activities planned under the proposed ADB funded socio-economic study.

A special effort should be made to identify donor agencies that will sponsor overseas study for advanced degrees at institutions with a reputation for expert training in animal breeding

## **5. International Network for Genetics in Aquaculture (Immediate Object 5)**

The development of an international network for the coordination of breed development is a valuable undertaking and the panel commends the GIFT project for the effort. However, the development of the network will require careful planning and strong administrative support. The panel recommends that ICLARM incorporate the networking approach as a significant component of its germplasm enhancement thrust.

The GIFT project does not have the resources or the manpower to develop INGA. The GIFT project sponsoring agencies requested the development of a network as part of GIFT but are not able to fund the activity.

The minimum needs are a coordinator, a second quantitative geneticist, and funding for steering committee meetings, site tours, communications, and publications. These needs cannot be provided by the GIFT project as presently funded.

The panel finds that the recruitment of a second quantitative geneticist is essential. This will provide the urgently needed additional man power for the strategic genetic research as well as technical support for INGA. Recruitment in this discipline will provide broader assistance than would be gained by hiring a population geneticist since a quantitative geneticist

should be able to provided the level of scientific support needed in the area of germplasm management.

The panel recommends that UNDP provide minimum immediate funding to carry INGA through 1994. This funding should be sufficient to ensure a successful first meeting of the steering committee, extend the coordinator position through 1994, and provide ICLARM and INGA the opportunity to seek complementary funding for the network.

## **Conclusions**

The panel was extremely impressed with the project, its achievements, the skill and dedication of the staff, and the level of cooperation among agencies. The project leader, the national staff, and the national government are to be commended for their dedication in the development of equitable research collaboration.

The project is demonstrating that national research services can apply modern animal breeding methodology to improve aquaculture production. The effort must be nurtured and supported over the long term is ensure that this excellent model of cooperation and research productivity reaches the maximum audience.

**Respectfully submitted,**

Dr. Graham A.E. Gall, Panel Chair  
Prof. Vo Tong Xuan  
Dr. Ziad Shehadeh

## APPENDIX I

## Advisory Panel Members

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## APPENDIX II

GIFT PROJECT WORKING GROUPS INTERVIEWED BY THE  
ADVISORY PANEL

AT NFFTRC/BFAR, FAC/CLSU and ICLARM  
8-9 NOVEMBER 1993

## A. GIFT PROJECT CORE STAFF

## SELECTION AND BREEDING GROUP:

Ruben Reyes	NFFTRC/BFAR
Marietta de Vera	ICLARM
Edna Dionisio	NFFTRC/BFAR
Lilibeth Afan	NFFTRC/BFAR
Hernando Bolivar	ICLARM

## BROODSTOCK/GERMPLASM/CRYOPRESERVATION MANAGEMENT GROUP:

Jodecel Danting	NFFTRC/BFAR
Felicisima Longalong	NFFTRC/BFAR
Ruben Reyes	NFFTRC/BFAR

## ON-FARM TRIALS

Hernando Bolivar	ICLARM
Ruben Reyes	NFFTRC/BFAR
Belen Acosta	ICLARM
Antonio Circa	FAC/CLSU

## DATABASE MANAGEMENT GROUP:

Teresita Gonzales	NFFTRC/BFAR
Gracita Navidad	NFFTRC/BFAR
M.J. France Rius	ICLARM
Divino Rosales	ICLARM



**SOCIO-ECONOMIC GROUP:**

Gaspar Bimbao	ICLARM
Dr. Mahfuzuddin Ahmed	ICLARM
Belen Acosta	ICLARM

**B: STRATEGIC PLANNING/TRAINING**

Dr. Ambekar E. Eknath	ICLARM
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**C. PHILIPPINE NATIONAL TILAPIA BREEDING PROGRAM**

Ruben Sevilleja	FAC/CLSU
Ruben Reyes	NFFTRC/BFAR

**D. INTERNATIONAL NETWORK ON GENETICS IN AQUACULTURE**

Dr. D.V. Seshu	Coordinator
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**E. ICLARM**

Dr. Larry Stifel	Director General
Dr. Roger S.V. Pullin	Director, Inland Aquatic Resource Systems Program

## APPENDIX III

LIST OF READING MATERIALS PROVIDED  
TO ADVISORY PANEL

GIFT Phase II Progress Report July 1992 to October 1993

GIFT Phase II Revised Workplan of Project Activities, Year 1

GIFT Phase II Plan of Project Activities, Year 2

International Network on Genetics in Aquaculture Papers

- Draft Report: First Meeting to Establish International Collaborative Linkages for Fish Genetics Research
- Recommendations of the Meeting on "International Concerns In the Use of Aquatic Germplasm
- Summary of Proceedings of "The Workshop on Networking for Genetics in Aquaculture

Recent Publications

- The Evolving Role of SQL in Genetics, Breeding and Selection Work
- Three papers published in Aquaculture, 111 (1993)
- Birth of the 'super' tilapia/Tilapia beats its critics in the US - Fish Farmer - Vol. 16 No. 5 September/October 1993
- GIFT Brochure

Supplementary Material

- UNDP/DGIP Mission Report on INGA (10 countries)
- GIFT Phase I Final Report
- Proposal 5th Draft - GLO/90/016 - GIFT Phase II: 1992 - 1997
- Naga - The ICLARM Quarterly April 1991
- Minutes of First and Second Tripartite Review Meeting

## Appendix IV

### Genetic Improvement of Farmed Tilapias - Phase II

## DRAFT SUMMARY FINDINGS OF ADVISORY PANEL

10 November, 1993

### OVERVIEW

The Panel was extremely impressed with:

- the progress achieved to date.
- the technical quality of the research
- the high skill level of the staff
- the high level of cooperation among agencies

The project is effectively demonstrating:

- how NARS can be true research partners
- the application of modern animal breeding methodology to tropical aquaculture
- an excellent model of cooperation among international NGOs and NARS

The Project Leader is commended for his leadership and dedication in the development of equitable research collaboration. The Panel also commends the enthusiasm and dedication of the national staffs, and the commitment of the national government.

### DETAILED COMMENTS

Detailed comments of the Panel deal primarily with the management and operation of the project, particularly what is seen as excessive expectation of GIFT and its project leader. Some comments also are offered on technical aspects of the strategic research section.

## 1. Strategic Research Activities (Immediate Objective 1)

### A. Selection Program

The panel finds that:

- the program is technically sound for the most part
- A complex system has been well implemented
- Accomplishments are significant

Comments on the technical aspects are:

Use of controls has not been consistent and effort has been excessive. A single unselected control, either repeat mating or standard strain, must be implemented each generation. Testing for farm performance should be done using separate protocols.

The project has not achieved true estimation of genetic response to selection due to lack of information on selection intensity. This should be corrected for the next generation so that realized genetic response can be estimated.

### B. On-Farm Trials

These trials have been well executed and should be continued. Some technical problems have arisen but were outside the control of the project staff. The use of control populations should be re-evaluated as per comments on selection.

### C. Dissemination of Germplasm and Improved Breeds

The Panel recognizes that dissemination of the 'GIFT' fish must be carried out but also finds that the project is not quite ready for the management of disseminated genetic material. Thus, caution and care are essential.

Three elements of concern are:

- Manual of procedures is not available.
- NARS do not have adequately trained staff
- Data on yield from field production trials are lacking.

In 1994, two of these concerns should be addressed. Procedure manuals must receive first priority. Yield data should be obtained from the on-farm trails to provide initial estimates of production performance. The training of staff will require a longer period and this issue is addressed by the Panel under the section on training.

#### D. Philippine National Tilapia Breeding Program

The organizational infrastructure is appropriate and well established. The potential for success is good within the concerns expressed under "C. Dissemination."

The immediate initiation of the country-wide program, as compared to a more moderate initiative will stress the PNTBP.

The Panel has some concern about how much input should be expected from the GIFT project even in the short term.

#### E. Estimation of Economic Benefits of Improved Breeds

The Panel has major concern about this aspect of the research. This objective is directed at the Luzon area of the Philippines. Part of its purpose is to support the GIFT research through providing data essential in defining the relative economic benefits of alternative genetic approaches to breed improvement. This is reasonable. Presumably, it also is directed at developing methodology for transfer to other areas and countries.

However, the study plan presented to the Panel was one to develop pre-release baseline data for the Philippines. It is to be based on the study of a minimum of 417 farms.

For GIFT project purposes, a smaller number of sites (20 to 40) should be identified for intense study involving controlled release of the improved breed. Post-release data should be collected for two years to provide initial estimates of economic impacts of switching to the improved breed.

This approach will aid in understanding the economic importance of various biological traits as well as the immediate effect of the use of an improved breed of tilapia on net farm production. Continuation of the study in parallel

with the Philippine study over a longer time period will be necessary for evaluation of social impacts.

The Panel does not believe GIFT staff should have major responsibility for the general Philippine study.

#### **F. Cryopreservation of Tilapia Spermatozoa**

This is an important aspect of the GIFT project as a means of testing the rate of selection response as well as serving as a storage backup for the live germplasm collection.

The project must publish a catalog of the germplasm for distribution. There does not appear to be a defined strategy or protocols for the transfer of frozen material; this should also be included in the catalog of germplasm.

#### **G. Database Management**

This work group has excellent skills and has done a good job of applying existing technology in designing a sound database.

Capabilities in data analysis are less clear. The project staff have not developed sufficient technical knowledge or training in quantitative genetic theory to effectively utilize the database.

In addition, the project appears to require upgraded computer hardware to fully utilize the database. The capability of accessing the complete data base also will be necessary for effective training of staff in advanced scientific and genetic skills.

### **2. New Traits (Immediate Objective 2)**

The evaluation of additional biological traits is essential to an effective breeding program. However, care need be taken to distinguish between objectives relating to new traits for possible inclusion in the ongoing selection program on one hand, and objectives relating to possible new directions for breed development to accommodate genotype-environment interactions on the other hand.

The study of age-at-maturity should continue, with special emphasis on methods of measuring the trait that express a high level of genetic determination.

The study of tolerance traits (temperature, salinity, disease, etc.) should be directed at screening germplasm; not the current GIFT nucleus breed. If and when appropriate genetic material is identified, then a determination can be made regarding its transfer into the GIFT nucleus. In any case, it is likely that a new breed will be required for release to the specific environments.

### 3. Collection of New Germplasm (Immediate Objective 3)

Collection of new germplasm should continue on a selective basis.

GIFT should cooperate with NARS to obtain pre-screening of material before it is added to the ICLARM collection. The network (INGA) should be a focal point for this cooperation.

### 4. Training (Immediate Objective 4)

GIFT should accept responsibility for training at two levels: staff at partner institutions and staff at collaborating institutions. Training of farmers and hatchery managers should be the responsibility of NARS. GIFT should concentrate on training the trainers.

#### A. Partner Institution Staff Training

The core staff at CLSU/FAC, BFAR, and GIFT have been well trained in skills and the procedures employed in current studies.

No systematic effort has been made to train the staff in basic quantitative genetic principles or the principles of the design, development and analysis of genetic studies.

The Panel underlines the need for a more systematic approach to scientific training for in-house staff.

GIFT should develop a specific course on genetic principles, estimation of quantitative genetic parameters, and the analysis of selection response. This should be done by contracting with an international expert(s) for the presentation of a course with a duration of about three months, possibly offered in two six-week modules. The course should be complete with teaching material, final examinations, and the awarding of diplomas for successful completion.

GIFT should organize short-term study tours at Advanced Scientific Institutions for interested staff.

Consideration should be given to developing an M.Sc. program with an animal breeding or plant breeding program at a Philippine institution, possibly, the University of the Philippines, Los Baños.

#### B. Training at Partner Institutions

In the absence of a specialized training unit within ICLARM and the urgent need for a more systematic training effort, the GIFT project training work-group should be strengthened by the addition of specialized consultants.

The consultants should plan and prepare training material in consultation with project technical staff. The training material should be directed at scientists and extension specialists. It should be appropriate for the Philippine effort, INGA activities, and for the purposes of the ADB project.

A special effort should be made to identify donor agencies who will sponsor overseas study for advanced degrees at institutions with a reputation for expert training in animal breeding.

#### 5. International Network for Genetics in Aquaculture (Immediate Object 5)

The development of the network is a valuable undertaking and the Panel commends the project for the effort. However, the development of the network will require careful planning and strong administrative support. The Panel recommends that ICLARM incorporate the networking approach as a significant component of its germplasm enhancement thrust.



The GIFT project does not have the resources or the manpower to develop INGA. Sponsors requested the development of a network as part of GIFT but are not able to fund the activity. The minimum needs are a coordinator, a second quantitative geneticist, and funding for steering committee meetings, site tours, communications, and publications. These needs cannot be provided by the GIFT project as presently funded.

The Panel finds that the recruitment of a second quantitative geneticist is essential. This will provide the urgently needed additional man power for the genetics strategic research as well as technical support for INGA. Recruitment in this discipline will provide broader assistance than would be gained by hiring a population geneticist.

The Panel also recommends that UNDP provide minimum immediate funding to carry INGA through 1994. This funding should be sufficient to ensure a successful first meeting of the steering committee, extend the coordinator position through 1994, and provide ICLARM the opportunity to seek complementary funding for the network.

#### Advisory Panel

Dr. Graham A.E. Gall  
Prof. Vo Tong Xuan  
Dr. Ziad Shehadeh

**PROGRAM RESPONSE TO THE  
FINDING OF THE EXTERNAL ADVISORY PANEL (EAP)  
OF THE GIFT PROJECT**

# **PROGRAM RESPONSE TO THE FINDINGS OF THE EXTERNAL ADVISORY PANEL (EAP) OF THE GIFT PROJECT**

The GIFT Team is pleased with the outcome of the review: the first sitting of the EAP, which will reconvene annually. The confidence expressed by the EAP and UNDP on the team's ability to implement a complex project will serve as an incentive to work harder. The extensive consultations with the EAP have paved a way for better understanding of the research and training priorities. Overall the GIFT team agrees with the major findings of the EAP in respect of strategic research and training activities. Responses are given here to all the main observations and suggestions of the EAP.

## **1. Strategic Research**

### ***A. Selection Program; and B. On-Farm Trials***

The EAP observed the inconsistency of *controls* used and the lack of information on *selection intensity*.

The suggestion of the EAP in respect of controls (in particular the use of repeat mating) is noted. During the first few generations of selection experiments, and for the purposes of scientific publications, the project opted to use a series of controls. Admittedly, some of these controls have not been consistent. For the purpose of on-farm trials, the project has used 'commercially used Israel strain' and wherever available the "conventional farmers' strains". This should serve adequately for demonstration purposes and estimation of potential economic benefits.

*Selection intensity*: The project has followed a complex combined family selection strategy. Calculation of selection intensity using this protocol is rather complicated, but we agree that it should be done. One possible way of estimating selection intensity is that based on the scale of estimated breeding values. Nevertheless, methods for estimating actual selection differential and realized genetic response will be explored.

### ***C. Dissemination of Germplasm and Improved Breeds***

The EAP has urged *caution*, commented on the *inadequate training* of NARS staff and on the *lack of yield data from field trials*.

The GIFT team has prioritized preparation of a Procedures Manual: target date for a working draft is April 1994, in time for the first INGA Steering Committee Meeting, NARS staff can only be trained adequately as national breeding programs are conceived and funded. More data from field trials are indeed needed. Because of the present heavy workload on the working group involved in on-farm trials, it is important that a Research Associate be hired on a short-term basis to compile and analyze data.

#### ***D. The Philippine National Tilapia Breeding Programs (PNTBP)***

The EAP was concerned about the *inputs needed* from the GIFT project.

The team fully agrees with the EAP's caution here. Much effort will be necessary to develop the PNTBP. This will mean extra work for the GIFT team, but there is no real alternative. The GIFT project fish will constitute the breeding nucleus for the PNTBP. Monitoring of broodstock, production of fry by farmers and provision of a feedback loop (on-farm performance and farmers' perspectives) into the breeding nucleus will be the responsibility of national lead agencies (Freshwater Aquaculture Center of the Central Luzon State University and the Philippine Bureau of Fisheries and Aquatic Resources). It will be some time before the national lead agencies can implement effectively the various key elements of the PNTBP. However, at a meeting in January 1994, the Department of Agriculture pledged substantial financial support for the PNTBP.

#### ***E. Estimation of Economic Benefits***

The EAP had major concerns about the *lack of strategic research* here and the pressure on GIFT staff to focus efforts on the Philippines.

The various concerns expressed by the EAP will be used to develop a more realistic strategic workplan. Further articulation and implementation strategies will be under the leadership of ICLARM resource economist Dr. Mahfuz Ahmed, who is expected to move from Bangladesh to Manila in 1994. An ADB-funded project, to be led by him, will consider the economic impact of new breeds in Bangladesh, China, the Philippines, Thailand and Vietnam.

#### ***F. Cryopreservation of Tilapia Spermatozoa***

The EAP suggested: (i) the preparation of a *catalog of germplasm* for distribution; and (ii) *protocols for transfer of frozen spermatozoa*.

A catalog of families and other information pertaining to the broodstock to be distributed to various multipliers of PNTBP is already under preparation. A clear strategy for dissemination of germplasm and GIFT-developed breeds should emerge from the INGA Steering Committee, depending upon the needs and opportunities in each of the member-countries of INGA.

#### ***G. Database Management***

The EAP had concerns about the *lack of training of GIFT personnel* and of *modern computer hardware* at ICLARM.

The GIFT team realizes that the project database provides a unique opportunity to address strategic research questions pertaining to the genetics of finfish. It is unique.

To utilize this database effectively, as pointed out by the EAP, there is a need for upgrading computer resources and training the project staff. The strategy will be to invite well-known quantitative geneticists (for example, those on their sabbatical leave) to assist in training and in the analysis of the data, and to upgrade available hardware.

## 2. New Traits

The EAP urged caution in distinguishing between *objectives relating to new traits* (for possible inclusion in selection programs) and those relating to *breed development to accommodate G x E interaction*.

The team agrees with the EAP.

## 3. Collection of New Germplasm

The EAP suggested *cooperation with NARS and pre-screening material* in the countries of origin before adding to the ICLARM collection.

The team agrees with the EAP. The germplasm collected from Egypt in October 1992 is already being screened for salinity and cold tolerance. For further research leading to development of new breeds for specific environments (salinity, cold or disease resistance), new partners will be sought among the INGA NARS members.

### 4.A. Training of Staff in Partner Institutions (Freshwater Aquaculture Center and Bureau of Fisheries and Aquatic Resources)

The EAP observed a *deficiency in training* in basic quantitative genetics.

The EAP is correct. During the GIFT Phase I, training of project staff was focused on the skills and procedures necessary to implement the planned project experiments effectively. Because of the tight time schedule, a systematic approach to train the staff in basic quantitative genetics could not be accomplished. During the current phase of the GIFT project, as suggested by the EAP, experts will be contracted to present an intensive course in quantitative genetics. During the training, promising areas of research will be identified for subsequent M.Sc. programs.

### 4.B. Training of Researchers at Partner Institutions

The EAP urged a more *systematic training effort* and the use of specialized consultants.

This will largely depend on the needs and priorities to be identified by the INGA members. However, the intensive course on quantitative genetics (see 4.A. above) should be open to all INGA members. Consultants cost money, so resources will be needed to tap their talents.

## 5. International Network on Genetics in Aquaculture (INGA)

The EAP *endorsed the establishment of INGA* and suggested that the minimum staff for its successful operation are *a coordinator and a second quantitative geneticist*. It will also require *adequate operational funds*. None of these requirements can be provided by the GIFT project as presently funded.

Funding for and recruitment of an INGA coordinator are indeed essential and urgent. These will be accomplished in 1994. The recruitment of an additional quantitative geneticist is possible through ICLARM's IARSP program, as outlined in ICLARM's Medium-Term Plan. However, the Center will not have adequate resources for this to be a new core hire in 1994-95. Instead, complementary funds for a visiting scientist will be sought. The EAP clearly regarded the term "population geneticist" as having a rather narrow meaning. What ICLARM was seeking under this heading was biodiversity research expertise as it relates to the emergence and sustainability of breeding programs. This search will continue.

**FRAMEWORK FOR PHILIPPINE NATIONAL TILAPIA  
BREEDING PROGRAM (PNTBP)**

(REVISED VERSION)

June 1993

*DRAFT WORKING  
DOCUMENT*

FRAMEWORK FOR PHILIPPINE NATIONAL TILAPIA  
BREEDING PROGRAM (PNTBP)

June 1993



## Contents

1. Introduction
2. Organization and Structure of PNTBP
3. The Process of Multiplication and Dissemination
4. Strategies for a Self-sustaining PNTBP

## FRAMEWORK FOR THE PHILIPPINE NATIONAL TILAPIA BREEDING PROGRAM (PNTBP)

### 1.0. INTRODUCTION

The significant achievements attained in tilapia genetics research favor the development of the tilapia industry. The recently concluded Phase I of the collaborative research project on the 'Genetic Improvement of Farmed Tilapias' (GIFT) has succeeded in developing an improved tilapia breed which outperforms the Philippine commercial tilapia strain by 60% in growth and survival.

This can pave the way for a 'blue revolution' in many developing countries, particularly in the Philippines where the tilapia (*Oreochromis niloticus*) is becoming increasingly important. The Philippine Bureau of Agricultural Statistics reported that the volume of tilapia produced from the country's inland waters is substantial. The tilapia aquaculture production data for 1991 was 76,570 tonnes, with production from freshwater fishponds (48.8%) contributing the biggest bulk (BAS, n.d.).

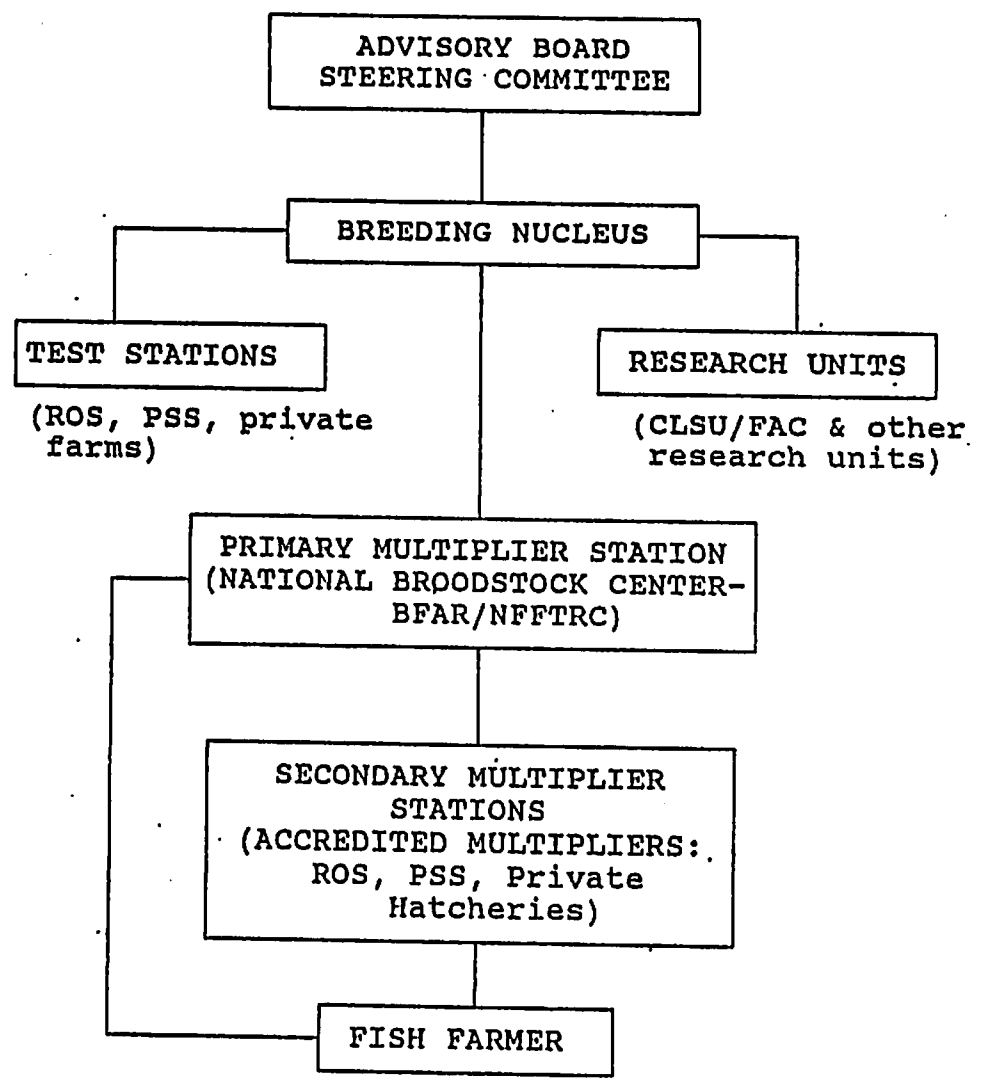
At present, one of the priority thrusts of the Philippine Government is self-sufficiency in food production. Thus, there is a pressing need to sustain the gains achieved from the tilapia genetics work. It was recognized that this can be accomplished by establishing a well organized National Breeding Program. This pioneering effort in the Philippines will also provide an example of how a national fish breeding program can evolve from other developing countries.

As an initial step in fulfilling this need, the GIFT Project, through the sponsorship of the United Nations Development Programme/Division for Global and Interregional Programmes (UNDP/DGIP), convened a GIFT Training Workshop on 10-13 May 1993 in National Freshwater Fisheries Technology Research Center/Bureau of Fisheries and Aquatic Resources (NFFTRC/BFAR), Muñoz, Nueva Ecija. This meeting focused on formulating strategies for the establishment of the Philippine National Tilapia Breeding Program.

This report is an output of the discussion among representatives of the collaborating institutions; (NFFTRC/BFAR), Freshwater Aquaculture Center/Central Luzon State University (FAC/CLSU), International Center for Living Aquatic Resources Management (ICLARM) and AKVAFORSK (Institute of Aquaculture Research, Norway).

## 2.0 ORGANIZATION AND STRUCTURE OF THE PNTBP

The proposed structure of the PNTBP will be as follows:



## 2.1 Advisory Board

An Advisory Board will be constituted to provide policy guidelines for the operation of the program. It will also be tasked with the responsibility of determining the breeding goals. The Board will be composed of representatives from the breeding nucleus, research units, relevant government agencies, multipliers and fishfarmers. It is very important that farmers be involved in the discussion of breeding goals because they are in a better position to say what the industry requires in terms of developing new breeding goals.

Membership to the Board shall be by invitation. The Bureau of Fisheries and Aquatic Resources (BFAR) in consultation with the lead agencies of the program, shall extend the invitation to potential members who will serve in the Board for a period of two (2) years.

## 2.2 Breeding Nucleus

The purpose of the Breeding Nucleus (BN) is to perform continuous, long term genetic improvement. The genetic improvement strategies developed by the GIFT project will be continued. The BN will be established in Muñoz, Nueva Ecija, Philippines and will occupy an 8-hectare area adjacent to the BFAR/NFFTRC and CLSU/FAC.

The functions of the BN are:

- a. Prioritize research needs and develop strategies for research in cooperation with the Research Units.
- b. Perform continuous selection
- c. Database Management
- d. Assist the National Broodstock Center in certification, monitoring and evaluation of multipliers
- e. Advisory consultation services
- f. Evaluation of new breeding goals
- g. Documentation of genetic progress
- h. Data recording and retrieval from test stations
- i. Production and distribution of fish to National Broodstock Center (see below) and Test Stations
- j. Networking

Genetic management techniques such as for production of monosex tilapia, ploidy manipulation etc. will be implemented outside the BN and only after the Research Units have ascertained the applicability of such techniques in the breeding program.

### 2.3 Test Stations (TS)

The purpose of the TS is to provide reliable field testing records to the BN. An important additional purpose is to operate as a security back up of the BN families. The TS should keep the fish alive/not take out fish without prior approval from the Breeding Nucleus.

Seven (7) test stations have been suggested for family and group testing. These stations include the following:

- a. "on station" environment which will be composed of the two national research centers (FAC-CLSU and BFAR-NFFTRC) located in Muñoz, Nueva Ecija.
- b. Laguna ( c/o San Pablo, Los Baños or Bay BFAR stations) for monitoring the studies conducted in cages in lakes of San Pablo and Laguna de Bay.
- c. Pantabangan ( c/o the Pantabangan fish cage operators cooperative) for supervision and monitoring of cage experiments to be conducted at the reservoir.
- d. Magat ( c/o BFAR, ROS, San Mateo, Isabela) for supervision and monitoring of cage experiments to be conducted in the reservoir of Magat.
- e. Pagbilao ( c/o BFAR-Brackishwater Fisheries Station) which will implement and conduct studies relevant to salinity tolerance and growth performance of improved strains of tilapia reared in brackish water environment.
- f. La Trinidad ( c/o BFAR Fisheries Station) will supervise and monitor the cold tolerance studies.

### 2.4 Research Units (RU)

The main function of the RU is to improve and update the PNTBP. It is responsible for calculating the breeding values, document genetic gains achieved, develop selection criteria for new traits, and package technology. It is important that the RU and the PNTBP seek the necessary funding outside of the program, although the PNTBP should also generate research funding for its own operation.

The Freshwater Aquaculture Center of Central Luzon State University (FAC/CLSU) will be the lead RU. Its functions include:

- a. Provide training
- b. Improvement of new traits
- c. Publication
- d. Technology verification
- e. Evaluation of new genetic management techniques
- f. Data analysis and computation of breeding values
- g. Complimentary experiments
- h. Documentation of genetic progress
- i. Provide policy guidelines & framework
- j. Fund sourcing
- k. Advisory and consultancy services
- l. Networking

## 2.5 Multiplier Stations (MS) : Primary and Secondary

The BN is not designed to produce enough breeders and fingerlings to satisfy the needs of the industry. Hence, two levels of multiplication are needed between the BN and the industry. The Breeding Nucleus (BN) will provide materials for strategic research and for further multiplication and dispersal through the Multiplier Stations. The Primary Multiplier Station will be the National Broodstock Center (BPAR/NFFTRC). During the first phase of implementation of the PNTBP, the second level of multiplication and immediate dispersal of improved breeds to farmers will be carried out through the Research Outreach Stations of the Department of Agriculture and the Provincial Service Stations of the Local Government Units.

### 2.5.1 The Primary Multiplier Station (PMS) - the National Broodstock Center

The main function of the NBC as the PMS is to use breeders supplied from the BN to produce breeders for the secondary level multiplier stations.

Other functions of the NBC are:

- a. Pricing/financing/marketing
- b. Multiplication/production
- c. Evaluation and certification of multipliers

- d. Gene banking
- e. Documentation
- f. Coordination of ROS, PSS, NGO's, GO's, LGU, etc.
- g. Policy guidelines
- h. Public relations
- i. Extension and training
- j. Advisory consultancy services

**2.5.2 Secondary Multiplier Stations (SMS)**

The main function of the SMS is to produce fingerlings for distribution to fish farmers from the latest generation of breeders received from the PMS (NBC). Because of its stated mandate, the NBC (BFAR/NFFTRC) will also function as a secondary level multiplier to produce fingerlings for grow-out operations. BFAR/NFFTRC will utilize separate facilities and will have its own working force for its role as a SMS.

The other important functions of the SMS are as follows:

- a. Purchase/buy/procure improved breeders from National Broodstock Center (PMS)
- b. Maintenance and multiplication of broodstock
- c. Distribution of fingerlings to fishfarmers
- d. Gather information and provide a feedback mechanism from fish farmers to the Breeding Nucleus and Research Units
- e. Act as extension agents for technology transfer
- f. Establish demonstration farms (pilot areas) in their respective provinces
- g. Conduct on-station research where appropriate following standard experimental protocols (in cooperation with BN and Research Units.
- h. Market referrals for fish sales
- i. Training of fishfarmers

***Potential Secondary Multiplier Stations***

During the first stage of implementation of PNTBP (1993/1994), five (5) Research Outreach Station (ROS) of the Department of Agriculture (DA) and two (2) Provincial Service Stations (PSS) under the provincial governments were identified as potential SMS in Luzon based on a survey done last April (see table below). Visayas

7  
and Mindanao multipliers stations are expected to be identified and to start operation next year (1994).

Upgrading of facilities in various SMS will soon be underway once funds are available from the Bureau of Agricultural Research (BAR). Prior to dissemination, training of superintendents and technicians from the multiplier station will be done.



Table ..... List of ROS and PSS identified during April 1993 to serve as SMS of PNTBP.

Region	Locality	Area (ha)	Classification	Area (ha) intended for production
I	Laoag	1.75	PSS	1
	Paoay	1.00	ROS	0.5
	Pasuquin		PSS	
	Batac	10.30	PSS	
	Natividad	8.00	PSS	1
II	San Mateo	2.70	ROS	1
III	Looc, Zambales	4.40	ROS	2
IV	Bay, Sto. Domingo	9.8	ROS	2
V	Bula	6.0	ROS	1
	Buhi	2.0	ROS	1
C.A.R.	La Trinidad	1.7	ROS	1
TOTAL				10.5 ha

### 2.5.2.1. Accreditation Of SMS

Accreditation or certification will be of two types: the first certification is for the ROS/PSS and the other is intended for private hatchery operators.

Requirements to be a certified multiplier (ROS/PSS) are the following:

- a. Willingness to sign a Memorandum of Agreement with the PNTBP. The MOA contains conditions, provisions, standard operating procedures, safety measures and other aspects related to the dissemination of GIFT tilapia.
- b. Must meet the technical requirements
- c. Should have the minimum fish pond facilities

Private hatcheries will likewise serve as SMS upon accreditation by the NBC. To qualify as SMS, the private hatcheries must satisfy a set of criteria to be formulated by the NBC, after which a Certificate of Accreditation will be issued. A memorandum of Agreement between the private hatchery and the NBC will also be executed to formalize the tie-up for multiplication and distribution.

Requirements to be a certified multiplier (Hatchery Operator):

1. Bonafide hatchery operator
2. Willingness to sign an MOA with PNTBP
3. Must meet the technical requirements
4. Should satisfy the minimum fish pond facilities

The BN, NBC, BFAR and PNTBP will be the deciding and approving parties for accreditation/certification.

## 2.6 Farmers

The fish farmers are the recipients of the improved tilapia from the multiplier stations for production and/growing to marketable size. The farmers, through their associations or cooperatives, will be instrumental in giving feedback to the BN for improvement of traits. The farmers being important components of the PNTBP can avail of training courses on the care and maintenance of enhanced breeds of tilapia through farmers' training courses.

### 3.0 THE PROCESS OF MULTIPLICATION AND DISSEMINATION

#### 3.1 Breeding Goal

The PNTBP will initially focus on improving the growth performance of tilapia. Other traits of economic importance such as age at maturation, carcass quality etc. will be included in the breeding program in a phased manner.

#### 3.2 The role of Breeding Nucleus

As stated above, the BN will provide materials for strategic research and for further multiplication for eventual dispersal to farmers.

*Note: The BN is vulnerable to accidents and spread of diseases and parasites. It is therefore important to have a backup of all selected breeders. The TS to certain extent will serve as a security against accidental loss of stocks. Permanent backup measures should be explored as soon as possible.*

A total of three hundred breeders per generation, one hundred males and two hundred females, will be chosen for breeding according to their estimated breeding values. A nested mating design, one male mated to two different females is set up every generation to produce about two hundred full-sib families. From the time of stocking of breeders in hapas, the first collection of fry happens after 15 days from stocking. The swim-up fry collected will be reared in fine mesh hapas for about 21 days and then transferred to the rearing hapas (B-net) until they reach a size of about 3 g when they are tagged using fingerling floy tags and distributed for testing in various test stations (TS).

#### 3.3 Transfer from BN to PMS:

Fingerlings for transfer to the PMS (NBC) will come from about 300 families (including the 200 families used for strategic research). A total of about 90,000 fry or fingerlings can be produced in the breeding nucleus. The fingerlings from several families (about 15-20 families) will be grouped, marked, and distributed to the PMS. The idea behind group marking is to avoid mating of individuals from closely related representative families. The PMS will rear the fingerlings received from the BN. The breeders will then be distributed to SMS.

#### 3.4 Transfer from PMS to SMS

The SMS will receive breeders from the PMS and can start producing the fry and fingerlings for distribution to the farmers. Mass production of fingerlings will be done in designated ponds in each SMS following standard broodstock management procedures.

The SMS will liaise with fishfarmers on a regular basis. The farm records maintained by the farmers will be monitored regularly. Upon termination of the production cycle, the farm records will be collated and transferred to the BN for analysis.

## 3.5 Proposed timetable for Phase I of the dissemination.

DATE	ACTIVITY
May 14'93	Symbolic transfer of fingerlings to multipliers by the President of the Philippines Fidel V. Ramos
??	Release of funds and Rehabilitation of ROS/PSS
October 93 ---	Distribution and rearing at multiplier stations
??	Production of fry/fingerlings; (3rd week) release and dispersal to farmers

## 4.0 STRATEGIES FOR A SELF-SUSTAINING PNTBP

The GIFT project has its own life span and the people and donors behind it will not be there always to keep the genetic improvement work going. When the project ends and becomes a national program, it has to be in a self-sustaining mode to maintain its personnel and its activities.

## 4.1 Requirements of PNTBP

## 4.1.1. Personnel

A total of 28 staff members are currently working with the GIFT Project. It is envisioned that the same staff will be absorbed to run the Breeding Nucleus.

STAFF	NFFTRC	FAC
<i>Project Hired:</i>		
Research Assistants	2	2
Field Assistants	7	2
Support Staff	2	-
	<u>11</u>	<u>4</u>
<i>Seconded Staff:</i>		
Project Manager	1	1
Sr. Research Leader	1	1
Research Leader	1	-
Study Leader	1	1
Support Staff	3	3
	<u>7</u>	<u>6</u>

*The proposed minimum staff requirement will be:*

Staff	Project Hired	Seconded Staff
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Administrative:

Administrator	x	
Accountant	x	
Clerk	x	
Driver	x	
Driver	x	
Purchaser	x	

Technical:

Research Assistants	x	x
Data Encoders	x	
Field Assistants	x	
Farm Managers	x	

#### 4.1.2. Facilities

Breeding Nucleus - to be established (through the UNDP-GIFT project)

National Broodstock Center - existing BFAR-NFFTRC facilities

Research Units - existing CLSU-FAC facilities

Multiplier Stations - existing DA ROS/PSS facilities (with required repairs and upgrading through BAR grant)

#### 4.1.3. Administrative and institutional arrangements

The existing CLSU-BFAR Memorandum of Agreement should be reviewed and updated to address exclusively the institutional arrangement for the national breeding program. Legal arrangements between NBC, lead agencies, the Department of Agriculture, should be established. This will include the legal concern on the issuance of certificates of accreditation of multipliers.

## 4.1.4. Estimated Budgetary Requirements

	Per Month	Per Annum
<b>1. Personnel Services</b>		
1.1 Salaries (Project Hired)	P 63,850	P 766,200
1.2 Benefits		
Insurance/Medical	7,000	84,000
Bonus (13th month pay)		63,850
Cash Gift	1,250	15,000
PERA	7,500	90,000
1.3 Productivity Incentive	18,150	217,800
1.4 Contractual Services	50,000	600,000
Sub-Total	<u>P 147,750</u>	<u>P 1,836,850</u>
<b>2. Maintenance and Other Operating Expenses</b>		
2.1 Supplies and materials (farm input, office supplies, etc)	50,000	600,000
2.2 Communication	7,500	90,000
2.3 Local Travels	30,000	360,000
2.4 Electricity & power charges	10,000	120,000
2.5 Rentals & other fees	15,000	180,000
2.6 Repairs & maintenance	30,000	360,000
2.7 Other services, training	20,000	240,000
Sub-Total	<u>P 162,500</u>	<u>P 1,950,000</u>

3. Capital/Equipment Outlay (for initial set-up over a period of about 5 years):

3.1	Vehicles (3)	3,000,000
3.2	Laboratory equipment	1,000,000
3.3	Pond equipment	1,000,000
3.4	Tools/other equipment	200,000
3.5	Future expansion	5,000,000
	Sub-Total	<u>P 10,200,000</u>
	Estimated running cost (approximate)...	P 4,000,000
	or (per month)	P 333,333

4.2 Proposed Strategies for a Self-sustainable PNTBP.

Options for Self-sustainability

The efficient and smooth operation of the NTBP can only be attained if it is capable of generating sufficient income to sustain its activities. Several options are herein presented to ensure the sustainability of financial resources for the program.

1. Establishment of a foundation to oversee the management and "business" operation of the NTBP
2. Direct appropriations through legislation for the NTBP to become a specialized government program
3. Inclusion of a specific line item within the regular budget of the Department of Agriculture

## Fund Generating Strategies

There are several ways wherein financial resources can be generated. Among the strategies being considered are as follows:

1. From the regular sales operation of the NBC (BFAR/NFFTRC), a sharing system in the proportion of 60% to the Breeding Nucleus (BN) and 40% to the national treasury is contemplated. (At present, this is not possible and may require special legislation to be implemented.)
2. Payment of royalties by the multipliers. This is the payment of a pre-determined amount to be built-in in the cost per broodstock which the multipliers pay to the BN.
3. For a certain number of broodstock supplied to the multipliers, a fingerling production quota will be set and from there a fixed royalty will be paid to the BN. Any sales in excess of the quota shall accrue to the multipliers as their income.
4. Other sources
  - 4.1 Grants channelled to the foundation
  - 4.2 Donations
  - 4.3 Fees (consultancy, training fees, services, etc.)
  - 4.4 Credits through lending facilities



Summary of Proceedings

of

**THE WORKSHOP ON NETWORKING FOR GENETICS IN  
AQUACULTURE**

17-23 July 1993  
ICLARM Headquarters  
Makati, Metro Manila, Philippines

## **WORKSHOP ON NETWORKING FOR GENETICS IN AQUACULTURE**

A workshop sponsored by the United Nations Development Program (UNDP) with a focus on international collaboration in fish genetics research was held from 17 to 23 July 1993 at the ICLARM headquarters at Manila, Philippines. The objectives of the workshop were:

- 1) To exchange information on current status and future needs of genetics in aquaculture among selected countries from Asia and Africa and,
- 2) To discuss and finalize plans for establishment of an International Network on Genetics in Aquaculture.

The workshop was preceded by visits to prospective network member countries in Asia and Africa by a UNDP/DGIP mission led by Dr. D. V. Seshu of IRRI, who served as the network consultant. National program scientists and administrators representing the ten countries visited by the UNDP mission participated in the workshop. The countries include six from Asia (China, India, Indonesia, Philippines, Thailand and Vietnam) and four from Africa (Cote d'Ivoire, Egypt, Ghana and Malawi). In addition, representatives from FAO, SIFR, UNDP, NACA and AKVAFORSK were present at the workshop.

The discussions at the workshop led to an agreement to establish an International Network on Genetics in Aquaculture (INGA), to be coordinated by ICLARM. The objectives of the network, the needs of the eleven countries initially joining the network (10 countries mentioned above plus Bangladesh), and the expected inputs from and benefits to the participating countries and ICLARM are summarized in Attachment 1.

The workshop discussions were also focused on management of the network (Attachment 2), protocols for international introductions/transfers of fish (Attachment 3) and the research work plans for the first five years from the establishment of the network (Attachment 4). The agenda of the workshop and the list of the participants are given in Attachments 5 and 6.

**Attachment 1**

**ESTABLISHMENT OF AN INTERNATIONAL NETWORK ON  
GENETICS IN AQUACULTURE (INGA)**

## ESTABLISHMENT OF AN INTERNATIONAL NETWORK ON GENETICS IN AQUACULTURE (INGA)

### Network Objectives

#### *Immediate*

- o To evaluate, through linkages with national scientists and institutions, using standardized protocols, the culture performance of promising lines of tilapia and carps, in selected Asian and North African collaborative research partner countries (provisionally, Bangladesh, China, Egypt, India, Indonesia, the Philippines, Thailand, Vietnam) chosen to represent a range of agroclimatic and developmental scenarios wherein these species are important or potentially important for poor farmers and consumers.
- o To assess the needs and opportunities for the application of selective fish breeding, especially of tilapias, in African countries that represent a range of subregional environments (Eastern-Southern, Malawi; Northern, Egypt; and Western, Cote d'Ivoire, Ghana) in which inland aquaculture development is being pursued with tilapias as the most prominent farmable species and there are prospects for application of genetic research results.
- o To link together established and potential aquaculture geneticists from chosen collaborative research partner and a wider range of African and Asian-Pacific developing countries (for example, Fiji, Kenya, Malaysia, Tanzania, Uganda, Zimbabwe) so as to ensure mutual awareness of each other's activities in the application of genetics (principally selective breeding and biodiversity evaluation and conservation strategies) to inland aquaculture and to foster regional and interregional cooperation in research, training, conferences, joint publications and other information activities and mechanisms to speed the implementation of research results to benefit farmers.
- o To assist where needed the initiation of plans for national fish breeding programs.

#### *Long-term*

- o To contribute, through collaborative research, to the domestication and sustainable, profitable performance of tropical finfish species farmed in developing countries.
- o To strive for the conservation of biodiversity in farmed and wild populations of tilapias and other fish species prominent in inland aquaculture in developing countries.
- o To demonstrate that the application of genetics, especially selective breeding, can greatly increase the productivity, profitability and sustainability of low-cost input agriculture in developing countries and can thereby generate support for self-sustaining national fish breeding programs.

- o To strengthen the Long-term national capabilities for continued genetic enhancement of farmed fish through exchange of germplasm and methodologies and through training and interactive forums.

### **Common Needs for All Network Member Countries**

- o New, domesticated fish breeds to replace the breeds currently available for farming, which resemble wildtypes or are even worse in performance.
- o Guidance on how to establish and sustain national fish breeding programs.
- o Guidance on how to evaluate and conserve fish biodiversity for present and future utilization.
- o Definition of and typologies for fish farm environments to facilitate future work on genotype x environment interaction.
- o Guidance on how to estimate, ex-ante and ex-post, the environmental and socioeconomic impacts of development and utilization of new fish breeds in aquaculture.
- o Linkages to be aware of each other's activities and of global progress in the application of fish genetics to aquaculture and to facilitate regional and interregional cooperation.
- o Staff development in aquaculture genetics research, especially selective breeding.

### **Specific Needs for Collaborative Research Partner Countries**

#### **ASIA**

**Bangladesh:** Aquaculture forms part of a major development strategy in Bangladesh. Carp is considered one of the preferred species in pond culture. Needs: (i) technical support to develop breeding programs for silver barb and different carps; (ii) assessing the role of tilapia in mono- and polyculture.

**China:** The center of genetic diversity/aquaculture of Chinese carps. Needs: (i) technical support to develop breeding programs for Chinese carps; (ii) assessing the role of tilapia (including GIFT-developed greeds) in mono- and polyculture and different climatic conditions; (iii) developing cold-tolerant and salt-tolerant breeds of tilapia.

**India:** The center of genetic diversity of the Indian major carps, and the leading aquaculture nation in South Asia. Needs: (i) technical support to develop breeding programs for Indian carps; (ii) assessing the role of tilapia in mono- and polyculture.

**Indonesia:** One of the centers of genetic diversity of common carp, with apparently some traditional domesticated breeds. Needs: (i) evaluation, conservation and utilization options for 'locally' adapted breeds; (ii) dissemination strategies for new tilapia breeds.

*Philippines:* The leading country in Southeast Asia for tilapia culture and the base for ICLARM's collaborative genetic research activities. The Philippines is on the verge of developing a self-sustaining national breeding program for tilapias. Needs: (i) strategies for dissemination of improved tilapia breeds; (ii) technical support to sustain the critical-mass developed through the GIFT project, (iii) development of tilapia breeds for brackishwaters.

*Thailand:* A leading country in Southeast Asia for tilapia, carp and catfish culture. A strong team of aqua geneticists exist in Thailand. Needs: (i) developing appropriate breeding strategies and wider dissemination of improved breeds of tilapias and indigenous species.

*Vietnam:* A strong team of geneticists exists in Vietnam, with a good record of genetic improvement efforts for silver carp and common carp. Needs: support to ongoing activities in development of improved breeds of silver and common carp; (ii) germplasm from other sources (e.g. India) for developing improved breeds (e.g. rohu and mrigal); (iii) testing and dissemination of improved tilapia breeds.

## **AFRICA**

### *Eastern/Southern*

*(Malawi):* Assigned the leadership role in inland fisheries for the SADCC region. One of the important centers of genetic diversity of tilapias but lacking Nile tilapia and prohibiting the introduction of this and other exotic species: hence, a good case study for using indigenous species. Needs: (i) biodiversity evaluation and conservation; (ii) protocols for screening tilapia and other native species for aquaculture; (iii) guidance on founder stock establishment, broodstock management and first steps in selection breeding.

*Egypt:* Fast developing its aquaculture research programs; one of the important centers of genetic diversity of Nile tilapia. Needs: (i) evaluation of native Nile and other tilapias for commercial traits including growth, survival, cold tolerance and salinity tolerance and disease resistance; (ii) guidance for the development of selective breeding programs for tilapias and common carp.

### *Cote d'Ivoire and Ghana:*

Leading countries in aquaculture genetic research in West Africa and centers of genetic diversity for Nile and other tilapias. Needs: as Malawi above, but with a major focus on Nile tilapia and catfish.

### **Benefits to Participating Countries**

- o exchanges of new germplasm for inland aquaculture development;
- o conservation of aquatic biodiversity;
- o evolution of self-sustaining national fish breeding programs;
- o international exchange of staff and information;
- o new methodologies for fish breeding;
- o staff development.

### **Benefits to ICLARM as Part of the CGIAR**

- o furtherance of the strategic research agenda in ICLARM's Strategic and Mid-Term Plans, relating to improved, sustainable fish productivity through genetics and breeding;
- o efficient use of resources for a substantially decentralized fish genetics research thrust through collaborations with NARS and ASI's;
- o strengthening the center's role as a global resource for information on aquatic biodiversity and the application of genetics in aquaculture and as a source of germplasm for some strategic species.

### **Inputs from Collaborating Countries**

- o commitment of facilities and human resources for collaborative fish genetics research and associated training;
- o policies and resource allocations to foster the development, free exchange and testing of new fish germplasm;
- o commitment to the goals of developing self-sustaining national fish breeding programs;
- o free exchange of research results and commitment to co-publication;
- o strict adherence to International Codes of Practice for all germplasm transfers across national or significant ecological boundaries.

## Inputs from ICLARM

ICLARM will be a regular member of the network and will take responsibility for coordinating the network and hosting its secretariat:

### As a Coordinator -

- o Pursue funding for efficient coordination and operation of the network.
- o Organize meetings, exchange visits, and information dissemination to advance the network's agenda.
- o Facilitate linkages with other institutions and networks as deemed appropriate by the network members.
- o Publish an annual report on the network's activities and achievements.
- o Organize appropriate training programs.
- o Assist the network members where needed, in the planning and organization of their activities.

### As a Member -

- o Make available to its research products (improved fish breeds), and research methods and results.



**NETWORK MANAGEMENT**

## NETWORK MANAGEMENT

The group discussed various issues relative to network management for effective implementation of the program. At the outset it was emphasized that the management norms should reflect the fact that the network is jointly owned and organized by the participating NARS and ICLARM. The following decisions were taken:

1. Based on comparative advantage, it was agreed that ICLARM will coordinate the network, while it will be equal to other participants in its membership of the network.
2. A Steering Committee will be formed to formulate the plans and activities of the network and to discuss progress periodically. The committee will serve as a technical advisory body to assist the planning process. It will not have executive functions. It was agreed that the size of the committee will be limited to 11 members, in addition to the coordinator of the network. Some additional Resource Scientists (2 or 3) may be co-opted, as and when needed, for getting inputs on specific research issues. Appropriate criteria to be applied for the selection of the members of the Steering Committee have been discussed (attached). The Network Coordinator will serve as member-secretary.
3. There will be an annual meeting of the network starting in 1994, consisting of representative network scientists from different member countries and ICLARM to present and discuss the results of research/evaluation etc. planned at each center. This will be held in conjunction with a meeting of the Steering Committee, so that members common to both will not have to travel twice.
4. The coordinating centre will assume responsibility for information exchange (planned research results, as well as relevant research findings).
5. For material exchange, a small committee was formed to set the guidelines for transfer of fish across international boundaries (see attached Protocols for International Introductions/Transfers). Where exchange of fish for evaluation is planned, the materials should be sent directly by the country supplying to the country or countries receiving, without having to route through ICLARM. Shipping costs will be charged to the network operational funds, subject to these being available.
6. Joint visits to network research sites are considered an important mechanism for interaction among scientists, reviewing the network's progress, and formulating research strategies. As much as possible, such visits should coincide with the planned activities of related projects so as to maximize the use of time and funds. The

Steering Committee will decide on the schedule and places of joint visits to be fielded from time to time.

7. Activities and salient findings of the network will have to be effectively publicized by the coordinating center for attracting the attention of the policy-makers in different countries concerned, and of the potential donor community.
8. The Network of Aquaculture Centers in Asia and the Pacific (NACA), a regional intergovernmental organization agreed to cooperate with the network and supplement its efforts in achieving the common goals and objectives.
9. The network's progress and accomplishments will be subjected to periodical external review.
10. It was agreed that the network will be designated as "International Network for Genetics in Aquaculture (INGA)".
11. Two logos were received for the network.

## STEERING COMMITTEE MEMBERSHIP CRITERIA FOR MEMBERSHIP

### MEMBERS:

The Steering Committee will consist of 11 members plus the Network Coordinator who serves as Secretary.

#### From Network member countries (ten members):

Membership will be balanced between two categories of individuals:

1. Head or senior administrator involved in aquaculture research development in member country.
2. Senior Scientist in Aquaculture research and development in the national (focal) institution.

#### From ICLARM (One member):

Senior Scientist

The Chairperson shall be elected among the participating members.

### RESOURCE PERSONS:

Resource persons may be invited to attend meetings, as determined by the coordinating center. They will be:

Representatives of donor agencies of the network or  
Person(s) with experience in applied fish genetics and breeding.

### RELATED ISSUES:

(By-laws, tenure, frequency of meetings, etc.)

Shall be decided during the first meeting of the Steering Committee. In the meantime, ICLARM will prepare the draft terms of governance for consideration by the Steering Committee.

**PROTOCOLS FOR INTERNATIONAL INTRODUCTIONS/TRANSFERS**

## PROTOCOLS FOR INTERNATIONAL INTRODUCTIONS/TRANSFERS

The concerns in these respects were discussed in depth during the Meeting on "International Concerns in the Use of Aquatic Germplasm" in July 1992. Consequently this session felt it appropriate to draft the following memo which, after group discussion, was incorporated into the minutes of the present workshop.

"Any exchanges of germplasm among network members, that are undertaken under the auspices of the network, will follow similar procedures to those adopted by the GIFT project. These include application of the relevant codes of practice adopted by the GIFT project which incorporate socioeconomic, environmental and quarantine considerations prior to the transfer taking place. In the absence of an alternative system, network members will utilize the independent Advisory Group on introductions/transfers to be established by the GIFT project. The utility of this particular Advisory Group can be discussed at the annual meeting of the steering committee as and when necessary. The burden of responsibility in these respects rests with both the importing and exporting countries, i.e. both must be satisfied that the proper procedures have been followed prior to the exchange taking place. Information on exchanges undertaken, in each and every case, will be provided to ICLARM, as the network co-ordinator, in order that an accurate register of exchanges can be maintained."

**RESEARCH WORK PLANS**

## RESEARCH WORK PLANS

### I. SPECIES:

1. **Tilapia: Nile tilapia (*Oreochromis niloticus*).**  
Common to all countries, except Malawi where Nile tilapia is not found. Malawi will focus on *O. saka* and *O. karongae*.
2. **Carps:**  
**Common carp (*Cyprinus carpio*)**  
Common to Egypt, Indonesia, Philippines and Vietnam.  
  
**Grass carp (*Ctenopharyngodon idella*)**  
China and Egypt  
  
**Rohu (*Labeo rohita*) and Mrigal (*Cirrhinus mrigala*)**  
India, Thailand, and Vietnam

### II. IMMEDIATE COMMON OBJECTIVES:

1. Exchange of promising lines/breeds (Initial focus will be on locally available strains/lines).
2. Receiving GIFT developed improved tilapia breed for testing.
3. Characterization and evaluation of local material (for growth performance) in different farming systems and agro-climatic regions in each country.
4. Plans for developing national breeding programs.
5. Evaluation for specific traits (cold and salinity tolerance), disease resistance, and late maturity).

### III. PROTOCOLS FOR EVALUATION OF ECONOMIC TRAITS:

#### 1. Tilapia:

**Growth (*common to all countries*):**

Definition: time to reach market size

Recording: body weight

**Cold Tolerance (*China, Egypt, and Vietnam*)**

Definition: Ability to survive over wintering conditions;

Breeding goal: Survive temp. of 6-8 C for 1 week; and continue improvement for longer duration.

Recording: Standard challenge test; 50% survival



**Salt tolerance:** (*China, Egypt and Philippines*)

Definition: growth and survival in brackish water (10-15 ppt)  
Breeding goal: survival during peak saline conditions (20 ppt for 1 month)  
Recording: 1. standard challenge test; 50% survival (20 ppt)  
2. growth under normal brackish water conditions (10-15 ppt)

**Late Maturity:** (*Egypt and Philippines*)

Definition: Age at first spawning  
Recording: All or none trait, after observation of fry in the pond

**Resistance to Disease:** (*Philippines*)

Will be measured as 'non-specific' immunoparameters in blood serum.

**2. Carps:**

**Growth** (*common to all countries*):  
as defined above

**Resistance to external parasite** (*Argulus sp*): (*India and Indonesia*)

Recording: incidence and intensity of the parasite

**Late Maturity (Common carp):** (*Indonesia and India*)

Definition: Age at maturity  
Recording: secondary sexual characteristics

**IV. TRAINING:**

Scope: design of experiments; recording of traits;  
estimation of genotype x environment interactions.

**Attachment 5**

**WORKSHOP PROGRAM**

**JULY 17-22, 1993**

**WORKSHOP ON NETWORKING FOR GENETICS IN AQUACULTURE  
JULY 17 - 22, 1993**

**PROGRAM**

<b>July 16</b>	<b>Arrival of Participants Check-in Vacation Hotel, Makati</b>
<b>July 17</b>	<b>Field trip to Muñoz - the Home of GIFT project</b>
5:45 a.m.	Departure to Muñoz (160 km north of Manila)
9:00 a.m.	Arrival in Muñoz
10:00 a.m.	Tour of facilities: informal discussions with GIFT project personnel; finalization of country papers for presentation during the workshop.
12:30 p.m.	Lunch
2:00 p.m.	Continue discussions and finalize papers for presentation
6:00 p.m.	Early dinner
8:00 p.m.	Departure to Manila
11:00 p.m.	Arrival Vacation Hotel
<b>July 18</b>	<b>Free day (finalize papers for presentation)</b>

**NETWORK PLANNING WORKSHOP**

**July 19**

**Morning (8:30 - 12:00)**

**Session I. Opening Session**

**Chairperson: William D. Dar**

**8:30 - 9:00**

**Welcome**

**Dr. Larry Stifel  
Director General, ICLARM  
Dr. Manuel Lantin  
Undersecretary  
Department of Agriculture**

9:00 - 9:30	Opening Remarks	Mr. Abu Y.M. Selim UNDP Deputy Resident Representative
9:30 - 9:45	Coffee Break	
9:45 - 10:00	Adoption of Workshop Agenda	
10:00 - 10:40	Highlights of GIFT project experiences	Ambekar E. Eknath
10:40 - 11:10	Philippine National Tilapia Breeding Program	Ruben Sevilleja/ Melchor Tayamen
11:10 - 12:00	Economic Benefits of Applied Breeding Programs	Trygve Gjedrem/ Erling Fimland

*Afternoon (2:00 - 5:00)*

**Session II. Regional Collaboration and Highlights of Aquaculture Research**

**Chairperson: Tran Mai Thien**

2:00 - 2:30	Strategy for International Fisheries Research	Ziad Shehadeh
2:30 - 3:00	Network of Aquaculture Centers to Asia and the Pacific	Banchong Tiensongrusmee
3:00 - 3:30	Coffee Break	

**Session III. International Transfers of Fish Germplasm**

3:30 - 5:00	Roundtable Discussion	
	<b><u>Moderator: David Coates</u></b>	

6:30 p.m. *Dinner Reception*

**July 20**

*Morning: (9:00 - 12:00)*

**Session IV. Global and Interregional Cooperation**

**Chairperson: Nyle C. Brady**

9:00 - 10:00	International Collaboration through a Network Approach - Rice, a Case Study Durvasula V. Seshu
10:00 - 11:00	ICLARM's Medium Term Plans Larry Stifel
11:00 - 11:30	Aquaculture Genetics Research in Relation to FAO Projects David Coates
11:30 - 12:00	Promotion of Global and Interregional Cooperation - UNDP Perspective Nyle C. Brady

*Afternoon (1:30 - 5:30p.m.)*

**Session V. Present Progress and Highlights  
of Fish Genetics Research**

**Chairperson: Fatuchri Sukadi**

1:30 - 1:50	China	Li Sifa/Cui Lifeng
1:50 - 2:10	Cote D'Ivoire	Kassoum Traoure/ Jean-Francois Agnese
2:10 - 2:30	Egypt	Ahmad R. El Gamal/ Samir Ghoneim
2:30 - 2:50	Ghana	Charles Asafo/ Eddie Kofi Abban
2:50 - 3:10	India	P. V. Dehadral/ S. D. Tripathi
3:10 - 3:30	Coffee Break	

**Chairperson: LI Sifa**

3:30 - 3:50	Indonesia	Fatuchri Sukadi/ Endang Sri Heruwati
3:50 - 4:10	Malawi	Boniface Mkoko/ Sosten Chlota
4:10 - 4:30	Philippines	Ruben Sevilleja/ Melchor Tayamen
4:30 - 4:50	Thailand	Jarantada Karnasuta/ Somsri Ngamwonschong
4:50 - 5:10	Vietnam	Tran Mai Thien/ Nguyen Huu Dung
5:10 - 5:30	General Discussion	

**July 21**

*Morning (9:00 - 12:00)*

9:00 - 10:30

**Session VI. Network Proposal**

**Moderator: E. K. Abban**

10:30 - 12:00

**Session VII. Network Management**

**Moderator: Durvasula V. Seshu**

*Afternoon (2:00 - 5:00)*

**Session VIII. Network Workplans**

**Chairperson: S. D. Tripathi**

**July 22**

*Morning: (8:00 - 12:30)*

**Preparation of Draft Reports**

**July 22**

*Afternoon: (2:30 - 5:00)*

**Session IX. Summary of Workshop Proceedings**

**Chairperson: Larry Stifel**

<b>Network Management</b>	-	<b>D. V. Seshu</b>
<b>Steering Committee</b>		
<b>Membership</b>	-	<b>T. Banchong/E. Abban</b>
<b>Network Work Plans</b>	-	<b>S. D. Tripathi</b>
<b>Research Protocols</b>	-	<b>A. E. Eknath</b>
<b>Fish Transfer Protocols</b>	-	<b>D. Coates</b>
<b>Summary Remarks</b>	-	<b>D. V. Seshu/A. Eknath</b>
<b>Concluding Remarks</b>	-	<b>L. Stifel</b>

**July 23**

**Departure to respective countries**

**Attachment 6**

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MEETING TO DISCUSS THE STRATEGIES  
FOR SELF-SUSTAINABLE  
PHILIPPINE NATIONAL TILAPIA BREEDING PROGRAM  
(PNTBP)



**MEETING TO DISCUSS THE STRATEGIES  
FOR A SELF-SUSTAINABLE  
PHILIPPINE NATIONAL TILAPIA BREEDING PROGRAM  
(PNTBP)**

*Bureau of Soils Bldg., Quezon City, Philippines  
20 January 1994, 9:30 A.M.*

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## I. INTRODUCTION

- 1.0. The first meeting to discuss the strategies for a self-sustainable PNTBP was hosted by BFAR and ICLARM at the Bureau of Soils Bldg., Quezon City, Philippines on 20 January 1994.

### Attendance

- 2.0. The meeting was attended by officials of DA, ICLARM and its research partners (BFAR and FAC/CLSU) and UNDP Manila. Also present as observers were representatives from the DA ROS and members of the GIFT Project. A list of participants is contained in Annex 2.
- 3.0. The following documents were made available to the participants:
  - a. Agenda and List of Participants
  - b. Framework for PNTBP

### Opening of the Meeting

- 4.0. The meeting was opened with the introduction of the participants by the chairperson, Dr. Dar.
- 4.1. The participants were welcomed, on behalf of ICLARM, by Dr. Dillon. He remarked on ICLARM's excellent partnership with the Philippine national programs (BFAR, CLSU and UPMSD). He added that the launching of PNTBP by Pres. Ramos on 14 May 1993 is a significant milestone for the Center and its research partners.
- 4.2. Dr. Stifel explained that the GIFT Project is a global research effort with outreach to other countries. The working relationship that has developed in the project and the NTBP was seen as a model for international research. He specifically cited the recent selection of the GIFT Project by TAC of CGIAR as one of the four major breakthroughs in the entire CGIAR system during its annual meeting held in Washington in October 1993.

However, he expressed concern that the project has a finite life span and therefore needs a well-defined strategy on how to continue the program on a self-sustaining basis. In particular, the critical mass generated through this project needs to be maintained and strengthened further. Thus, he emphasized the importance of the present meeting in the evolution of PNTBP.

- 4.3. The UNDP representative, Mr. Pizarro, expressed the donor's appreciation to ICLARM and its partners for addressing the issue of sustainability through the PNTBP. He hoped that this would be an impetus for other donors to provide support.

- 4.4. Undersecretary Gerochi thanked the UNDP and ICLARM for their efforts in the PNTBP. He assured the group of the Philippine Government's support in this initiative. The President's launching of the program signified national interest in this activity. He hoped that this would become the flagship of the entire fishery sector in the country.
- 4.5. Dir. Morales added that given the limitations and strengths of the institutions involved in the project, well-defined strategies should be formulated to make the breeding program sustainable. He said these strengths can be pooled together to create a synergy.
- 4.6. Dr. Eknath commended: i) Undersecretary Gerochi for his support in the project and for facilitating the launching of the GIFT fish by Pres. Ramos, and ii) the entire GIFT staff for their cooperation and hard work.
- 4.7. Director Dar said the GIFT project is a trailblazing activity and the Philippine Government was particularly pleased to have been associated with the project. The DA through the FSP has allocated P7 million purposely to transfer the technology generated in Muñoz to the target groups.

#### Adoption of the Agenda

- 5.0. The chairperson stressed the importance of the meeting and the expected output. He requested the participants to address the issue of sustainability and focus the discussions on possible strategies.

## II. DISCUSSION AND FORMULATION OF STRATEGIES

- 5.1. Dr. Eknath introduced the draft working document "Framework for PNTBP" (Annex 3) and informed the Meeting of the rationale for setting up the PNTBP. He briefly explained its components: organization/ structure, sustainability and the proposed strategies for sustainability. He added that while the draft document outlined some options for sustainability, the Meeting would also welcome suggestions from the group on this issue.
- 5.2. The suggested options to sustain the PNTBP are: a) establishment of a sustainable non-profit institution/ committee (foundation) to oversee the management and business operation of NTBP; b) direct appropriations through legislation for the NTBP to become specialized government program; and c) inclusion of a specific line item within the regular budget of the Department of Agriculture.

The following options were discussed in detail:

#### Establishment of a Non-profit Institution (Foundation)

- 5.2.1. Dr. Stifel explained that foundation could be classified into two types: i) a foundation that derives its income from endowments (e.g. Rockefeller, Ford) and ii) an operating foundation - a non-profit organization which is established to carry out certain programs/objectives and derives its funding from a variety of sources (public and private). He also said that there is a

legal system for how a foundation should be established. A foundation with income from endowment is difficult in general and therefore not advisable. It was suggested that 'operating foundation' be adopted by NTBP.

- 5.2.2. Dir. Morales stated that a foundation which performs both research and business functions is perhaps appropriate. He added that the business aspect could be in the form of consultancy, fry/fingerling production. Hence, the source of funding should come from the earnings of the business operation and from contributions. However, Dr. Stifel stressed that this be properly defined because there are very strict rules imposed on operating foundations which are income-generating and tax-exempt.
- 5.2.3. It was agreed that a foundation should operate as a private organization with government infusion. This means that this will be cooperatively managed as a semi-commercial non-profit institution. The sustainability will partly come from the private sector (since the private sector will be encouraged to put back money into the research).
- 5.2.4. Dr. Dar cited existing foundations that are jointly managed by the government, academic institution and private sector (for example, NAADI and Banana growers foundation). He added that some government institutions have also initiated/organized foundations for their agribusiness venture (for example, CLSU).
- 5.2.5. Since NTBP is an offshoot of the GIFT Project, Dir. Morales inquired whether ICLARM could initiate the establishment of a foundation. Dr. Dillon replied that under the constitution, the Center is allowed to establish a foundation but still needs a host country arrangement with the Philippine Government and this could be the only impediment. Mr. Pizarro assured that UNDP will not pose any legal problem should ICLARM decide to establish a foundation.
- 5.2.6. Dr. Pullin inquired whether CLSU could establish a breeding unit and use a mechanism by which it could be funded from elsewhere. Ms. Cagauan replied that CLSU could do this but once the university gets the fund it is very difficult to retrieve this because it goes back to the national government. She also mentioned that the mechanism used by PCRDC (Phil. Carabao Research Development Center) in CLSU could be a good example.
- 5.2.7. Mr. Pizarro commented that to ensure the feasibility of the program, an established technotransfer program is needed. The success of the foundation will depend on the awareness of the private sector in this aspect.

#### Participation of Private Sector in the NTBP

- 5.2.8. Dr. Pullin cautioned that there could be risks in involving the private sector into the processes of breeding and multiplication. Thus, he reminded the group that proper accreditation of fishfarmers is needed. An initial plan would be to hold a meeting/ seminar with the private sector and discuss the whole process of accreditation, their roles and the economics of the breeding program.
- 5.2.9. Dir. Morales suggested that the role of the private sector vis-a-vis the role of the Government be defined. This is important in determining the extent

of involvement of the private sector in the breeding program and to avoid the danger of losing the improved tilapia breeds.

- 5.2.10. Undersecretary Gerochi replied that the private sector's main function is in the multiplication process. However, the sustainability of the GIFT Project depends also on the benefits or incentives which they could get from the GIFT fish.

#### **Inclusion of Specific Line Item Within the Regular Budget of DA**

- 5.2.11. Undersecretary Gerochi assured that direct appropriations could be obtained from the DA's FSP and BFAR's budget. He added that another option would be to tie up with organization like SEAFDEC for financial support since 80% of the Center's fund come from the Philippine Government.

- 5.2.12. Dir. Morales stated that there are some line items that BFAR could support. BFAR could commit P2 million per year for the maintenance and operating cost. However, remuneration (e.g. salary) for the staff in the Breeding Nucleus would be difficult. Thus, he suggested mixed sources of funds for the following:

initial term	-	UNDP and FSP
medium term	-	SEAFDEC
long term	-	Foundation or non-profit institution

- 5.2.13. Apprehension was expressed concerning the earlier suggestion to bring in a new organization like SEAFDEC into the breeding program. It was agreed that to avoid complexity, only institutions that are already part of the project will be involved in the NTBP.

### **III. SUMMARY OF CONCLUDING REMARKS FROM THE CHAIRPERSON**

The chairperson concluded that in the short term, no problems are foreseen in terms of sustainability of the breeding program because of the support that the project could get from UNDP and FSP. However, since there is a need to sustain this activity, the strategy for the sustainability of the program can be a combination of the following options:

- 1) to establish a non-profit organization with strong support of ICLARM and national programs that are already involved;
- 2) to bring in an already existing non-profit fisheries organization (e.g. PCAMRD).
- 3) active participation of the private sector in the NTBP.

**List of Acronyms**

<b>CGIAR</b>	-	<b>Consultative Group of International Agricultural Research</b>
<b>CLSU</b>	-	<b>Central Luzon State University</b>
<b>DA</b>	-	<b>Department of Agriculture</b>
<b>GIFT</b>	-	<b>Genetic Improvement of Farmed Tilapias</b>
<b>FSP</b>	-	<b>Fishery Sector program</b>
<b>ICLARM</b>	-	<b>International Center for Living Aquatic Resources Management</b>
<b>NAADI</b>	-	<b>Negros Agri-Aqua Development Institute</b>
<b>NTBP</b>	-	<b>National Tilapia Breeding Program</b>
<b>PCAMRD</b>	-	<b>Philippine Council for Aquatic and Marine Research and Development</b>
<b>ROS</b>	-	<b>Regional Outreach Station</b>
<b>SEAFDEC</b>	-	<b>Southeast Asian Fisheries Development Center</b>
<b>TAC</b>	-	<b>Technical Advisory Committee</b>
<b>UNDP</b>	-	<b>United Nations Development Programme</b>
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PHILIPPINE NATIONAL TILAPIA BREEDING PROGRAM  
THE (PNTBP): STRATEGIES FOR DISSEMINATION AND  
THE ROLE OF MULTIPLIER STATIONS

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ROLE OF MULTIPLIER STATIONS**

**Theme:**

*The Role of Multiplier Stations in Transferring the  
Genetic Gain (GIFT fish) to the Industry*

*Bureau of Soils Bldg., Quezon City, Philippines  
20 (P.M.) - 21 January 1994*

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## **List of Acronyms**

<b>BN</b>	-	<b>Breeding Nucleus</b>
<b>DA</b>	-	<b>Department of Agriculture</b>
<b>GIFT</b>	-	<b>Genetic Improvement of Farmed Tilapias</b>
<b>FAC/CLSU</b>	-	<b>Freshwater Aquaculture Center/Central Luzon State University</b>
<b>FSP</b>	-	<b>Fishery Sector program</b>
<b>ICLARM</b>	-	<b>International Center for Living Aquatic Resources Management</b>
<b>INGA</b>	-	<b>International Network on Genetics in Aquaculture</b>
<b>MTP</b>	-	<b>Medium Term Plan</b>
<b>NBC</b>	-	<b>National Broodstock Center</b>
<b>NFFTRC/ BFAR</b>	-	<b>National Freshwater Fisheries Technology Research Center/Bureau of Fisheries and Aquatic Resources</b>
<b>PMS</b>	-	<b>Primary Multiplier Station</b>
<b>PNTBP</b>	-	<b>Philippine National Tilapia Breeding Program</b>
<b>ROS</b>	-	<b>Regional Outreach Station</b>
<b>SMS</b>	-	<b>Secondary Multiplier Stations</b>



## 1.0. Introduction

Recognizing the need of a fish breeding program as a strategy towards increasing fish production, the Philippine government launched the PNTBP in May 1993. This was a significant milestone in the implementation of the GIFT project.

Since then, a draft framework for the PNTBP has been developed by the GIFT Project team for implementation by the national lead centers and the national tilapia breeding program. ICLARM and its national research partners will endeavor to make the PNTBP operational by 1994.

Accordingly, ICLARM and BFAR convened a meeting on 20 (afternoon) to 21 January 1994 at the Bureau of Soils Bldg., Quezon City, Philippines to discuss the important aspects of the framework with the key players of the breeding program - the multipliers.

The participants included leaders of DA and its ROS, ICLARM and its research partners (BFAR and CLSU) and members of the GIFT Project staff (see list of participants, Annex 1).

The summary of the proceedings is as follows:

### 1.1. *Opening Remarks*

BFAR Director Morales cited the increasingly vital role that aquaculture play in developing the economy of the Philippines. He referred to achievements in the GIFT Project as a significant milestone in the development of tilapia industry especially now that there is an increased demand of tilapia fingerlings due to expansion in freshwater/brackishwater aquaculture.

He also expressed concern that the improved tilapia breed has already gained the interest of Philippine national leaders and the private sector and this has created pressure on BFAR to make the improved tilapia breed available as soon as possible. In this connection, he requested everyone for more cooperation to speed up the delivery of commitment made during the launching of GIFT fish by the President of the Philippines, Fidel V. Ramos in 1993.

## 1.2. *Scope and Objective of the Workshop*

Dr. Eknath stated that the objectives of the meeting were to: i) inform the participants on the dissemination process which describes the flow of activities from BN to BFAR, secondary multiplier stations and farmers, and the components of PNTBP and their functions; ii) create awareness of ROS on the importance of their roles/responsibilities in the PNTBP; and iii) identify possible problems/difficulties that may impede the achievements of ROS as research partners and multipliers.

He also briefed the participants on the different sessions of the meeting and the expected outputs.

## 2.0. Summary of Presentations and Associated Discussions

### 2.1. *The Framework for PNTBP*

Mr. Reyes presented an overview of the PNTBP while Ms. Danting explained the different components of the breeding program (Fig. 1) and their functions; and the criteria for accrediting multiplier stations.

Ms. de Vera gave a detailed account on how a tilapia breeding program operates, including the time allotted for each activity (see Fig. 2). She stressed that an effective dissemination is possible only when there are organized channels for the production, multiplication and dissemination of genetic gain from the selection program.

#### 2.1.1. *Role of Farmer*

Dr. Eknath explained that the farmers will receive the improved breed fingerlings for grow-out operation; however, they should also cooperate and provide all the necessary information/data to SMS for feedback to BN and Research Units. The participants agreed and commented that this would therefore need careful management of stocks to avoid the loss of improved genes by contamination. They also suggested that a special training/briefing be given to farmers who will receive the improved breed for grow-out operations. These shall include; i) care and maintenance of improved tilapia breeds; and ii) economics of the breeding program (including record keeping).

### 2.1.2. *Role of PMS (NBC)/SMS (ROS)*

The role of PMS was clarified. PMS will receive the improved fingerlings from the BN to grow these to breeder size for distribution to SMS.

The SMS will then breed the fish and distribute the fingerlings to farmers. Some participants expressed concern that if the farmers, especially the 'moneyed', will buy fingerlings from the PMS and SMS, this may result in the collapse of private backyard tilapia hatchery (as in the case of Bay, Laguna). On the other hand, the participants remarked that this should not be the immediate concern since the PNTBP is still in its early stage. It was added that in the future, both the small- and big-scale tilapia hatchery operators can also participate as multipliers because of the limited supply in tilapia seeds.

The participating stations in Regions I-V agreed to conduct mainly research and partly produce fingerlings for distribution to farmers. As partner in research, it was made clear that ROS will collect information/data, identify problems and provide feedbacks from fishfarmers to the BN and the Research Units. They will also be responsible for selecting demonstration farms in their respective provinces and providing technical advice (including training) to farmers. In ROS where technical manpower are lacking, a technical person from the BN would regularly visit the multiplier stations.

A similar dialogue will be scheduled for ROS in Visayas and Mindanao since request for funds to upgrade their facilities have already been approved. The suggestion was for these stations to proceed with the preparation of their facilities while the other five stations in Luzon are being developed.

### 2.1.3. *Role of Private Sector*

Opinions on what should be the role of private sector in the PNTBP were sought. It was commented that the private sector should be the partner of government in augmenting the supply of fingerlings since, eventually, they will also become second level multipliers. The group was cautioned however on the need for well-defined protocols or an effective monitoring system to ensure proper management of stocks. The participants agreed that this would be a useful step.

#### 2.1.4. *How to select private sector as multipliers?*

Since the BN could only provide a limited number of fingerlings to PMS on its first year of operation, the suggestion was that initially, only selected private sector will be accommodated as multiplier. The ROS will select the private sector depending on their capability/willingness to participate in: i) research component; ii) concept of paying service fee; and iii) cooperation arrangement. Once selected, the ROS will invite the representatives of the private sector for a dialogue. The group also agreed that a Memorandum of Agreement between the private hatchery and the NBC will be executed to formalize the tie-up for improved tilapia multiplication and distribution.

#### 2.1.5. *Cost of GIFT fingerling*

Another issue raised was on the cost of improved tilapia fingerling. The participants were informed that this would be slightly higher than the prevailing cost of the commercial tilapia fingerling; but the price of each GIFT fingerling would be determined only after strategies for establishing a non-profit association/foundation shall have been finalized.

On the question of whether the farmers should be encouraged to use bigger size (12 or 14) fingerlings for stocking, the response was that bigger size fingerlings are generally more susceptible to stress/mortality during transport/stocking; hence, size 17 would be ideal.

#### 2.1.6. *New Traits*

On the enquiry of whether the GIFT project is developing strains for cold and salinity tolerance, it was replied that the genetic improvement program has initially developed tilapia strain for improved growth and has not included yet in its selection program the other economic traits such as cold and salinity tolerance. These traits however are already being investigated in the germplasm collected from Egypt in 1992. Future selection works leading to development of new breeds for these traits, will be carried out in research partnership with INGA member countries (for example, China and Vietnam).

Concerning the issue on reproductive performance of GIFT fish vs commercial strain and whether the GIFT fish is also late maturing, the response was that there are no concrete data on these yet although the genetic progress

resulting in delayed maturation of these stocks is also expected as soon as proper recording procedures are established and included in the selection protocols. Ideally, the fish should only mature 20 or 30 days before they are brought to the market.

## 2.2. Partnership Among Researchers-Multipliers-Farmers

Mr. Bolivar gave highlights on the project's first and second on-farm trials conducted in 1992 and 1993. He said that in both trials, the GIFT fish outperformed the Philippine commercial strain ('Israel') of tilapia in terms of growth.

Mr. Bimbao briefed the participants on the 3 phases of the Tilapia Economic Survey being conducted by the GIFT Project (National Production and Farmer's Census Survey; Pre-distribution Microeconomic Tilapia Farm Production Survey; and Post-distribution Microeconomic Tilapia Farm Production Survey); after which he discussed the details of the pre-distribution survey. He proposed that pre-distribution survey be conducted by the ROS to obtain baseline technical/socio-economic information on tilapia farms prior to introduction of GIFT fish.

The DA ROS in Regions I-V were also asked to participate in Phase 3 of the Tilapia Economic Survey. The activities will be mainly farm record keeping/monitoring and post-intervention survey which will be used to evaluate the impact of GIFT fish under farm condition. As an initial step, it was agreed that each ROS would randomly select a sample of farms (10-15) along a range of activities.

Ms. Dalusong explained that the project failed to incorporate the socioeconomic aspect during the previous on-farm trials hence the Phase 3 survey will be incorporated in the next on-farm experiment. She presented the draft farm record form, explained the information it required and how to fill-up the form. She said the farm record is crucial in establishing link between the researcher and the farmer; hence, she requested the participants to give their comments/suggestions to further improve the record form.

### 2.2.1. *Farm Record - A Key Link Between Farmers and Researchers*

The ROS will also be responsible for teaching farmers on how to maintain farm records.

Realizing however that most farmers are not, by experience, very keen in filling up a farm record form, it was suggested that this be limited (if possible) to only one page for easier compliance of the respondents. The following recommendations were also given by the participants to improve the form:

- simplify the form (if possible, use multiple choice instead of fill-in the blanks; translate into Tagalog or local dialect).
- provide a space for 'remarks'
- clarify each activity
- include the 'culture period' as another variable

### 2.2.2. *Constraints/Possible Solutions in Conducting Research (Economic Survey)*

The ROS participants were requested to identify the possible problems that might affect their participation in research and the solutions to these problems. The responses were:

Region	Problem	Solution/Remarks
I	Technical personnel are lacking (e.g. Paoay)	Regular visit of extension worker from BN
II	Some technical staff are unavailable	Staff from Regional Office will be assigned to ROS
III	None	FSP has provided funds for construction of hatchery
IV	None	Stations are ready
V	None	Stations are ready

To formalize the participation of ROS in the above research, letters requesting for the active involvement of the station's technical staff, preferably station managers, would be sent to DA Regional Directors as soon as possible.

### **2.2.3. *Next Meeting***

The group agreed to hold a follow-up meeting on the third week of February at NFFTRC/BFAR, Muñoz, Nueva Ecija. The main objectives of this meeting are to: i) inform participants on the breeding activities through on-site demonstration; ii) discuss and finalize list of farm cooperators; and iii) finalize farm records and the strategy for distribution of GIFT fish.

### **3.0. Concluding Remarks**

Dr. Eknath expressed gratitude to the participants for their cooperation and enthusiasm in making the meeting a fruitful and successful one.

Ms. Cagauan concluded that the GIFT fish is the product of a successful research collaboration and reminded the participants that the improved breed should be seen as a gift to the Filipino people, especially the poor fishfarmers. She therefore challenged everyone present in the meeting to cooperate because it is only through the concerted efforts that the ultimate objective of the project will be realized.

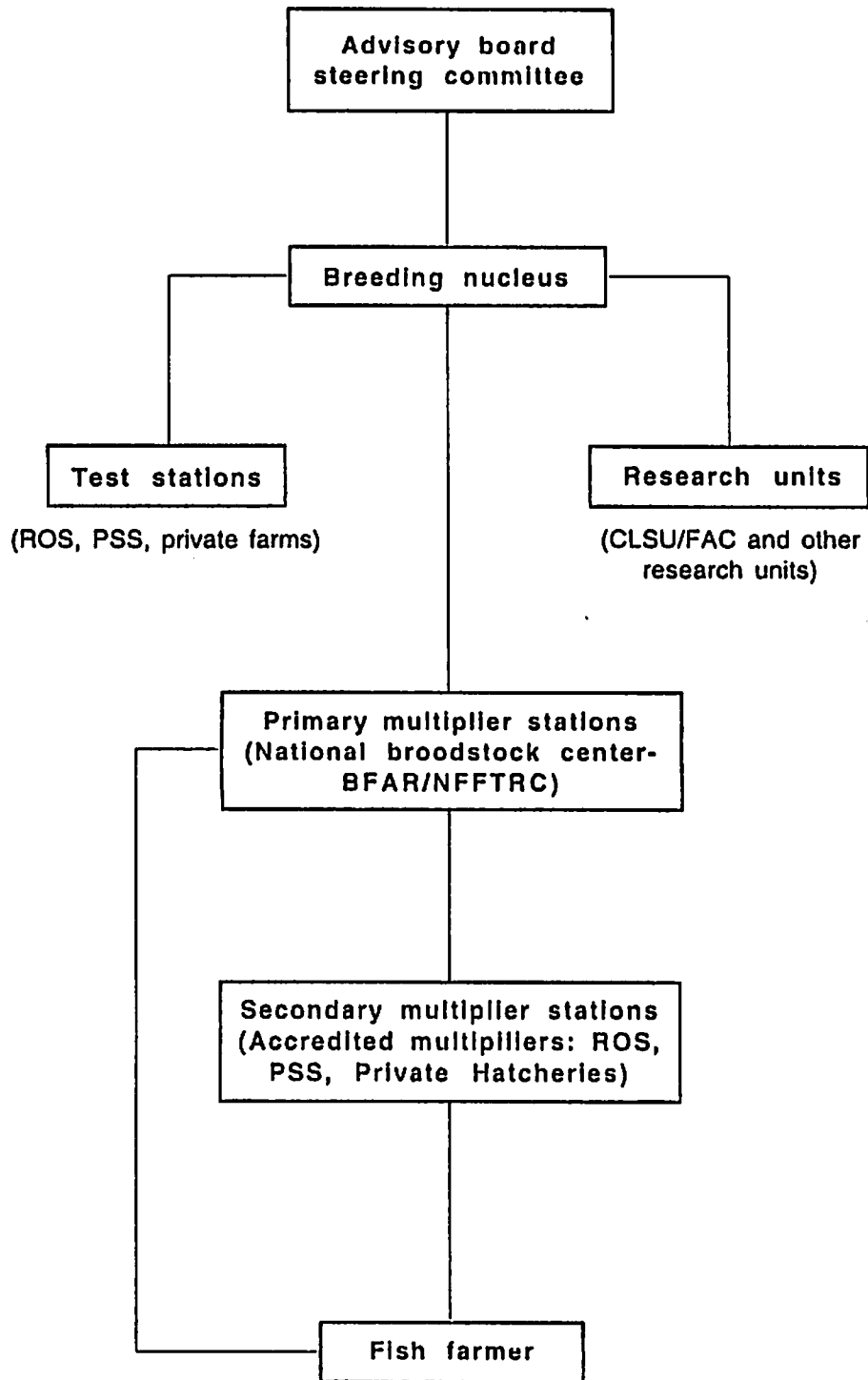


Fig. 1. Organization and structure of the PNTBP



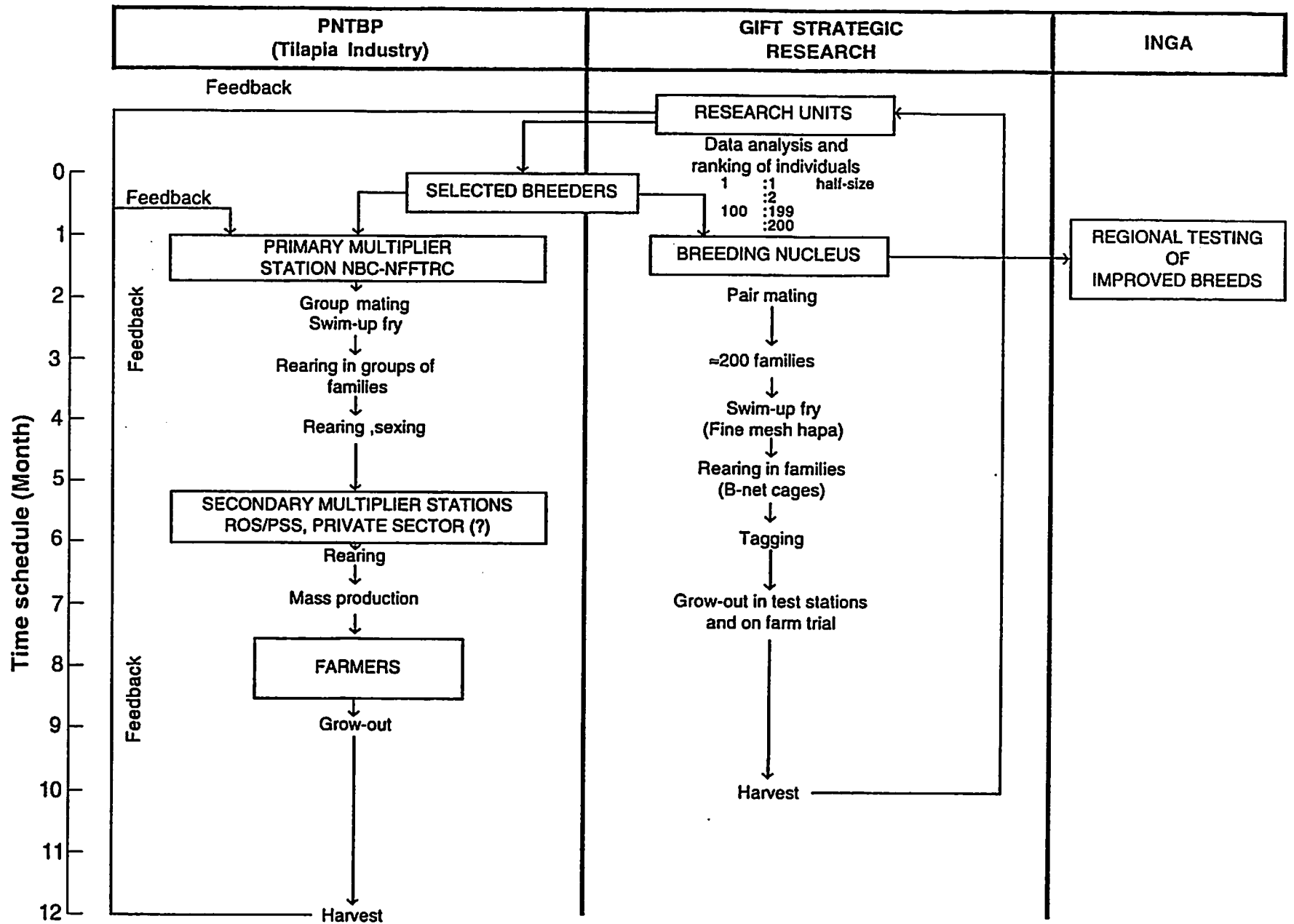


Fig.2. Schematic diagram of flow of genetic materials from GIFT project project to PNTBP and INGA.

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LIST OF EQUIPMENT

List of equipment to be procured during the first quarter of 1994. Detailed specification will be provided as soon as relevant details are obtained from suppliers.

1. Water quality kits (4 units)
2. Portable Water pump
3. Fingerling floy tags
4. Hand-held radio sets (6 pcs.)
5. Audio visual equipment (VHS/monitor)
6. Computer (4 units, 486 DX desk top)
7. Xerox machine
8. Fax machine
9. Computer chairs (5 units)
10. Filing cabinets (5 units)
11. Dewar (5 pcs. liquid nitrogen vessel)
12. Other consumables (hapa nets, B-nets)