

# AQUA CULTURE

A s i a P a c i f i c

**I**nnovative Intensive  
Shrimp Farming  
System in Vietnam

**F**rom Bali to Global  
Markets

**I**mproved Nile Tilapia  
Strain in Bangladesh

**P**erformance Feeds at  
TARS 2017

**K**rill Meal and High  
Salinity Shrimp  
Farming

**S**eafood E-Commerce:  
New Route to Market





GIFT tilapia in a basket, Bangladesh, p49.

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# Genetic improvement and effective dissemination of improved Nile tilapia strain in Bangladesh

By M. Gulam Hussain, AHM, Kohinoor, M. Moshir Rahman, M. Zillur Rahman, Abdullah Al Masum and Nguyen Hong Nguyen

GIFT strains and development of a hatchery industry contributed to the 19.5 times increase in tilapia production since 2005.

Tilapias have been proved recently as important and potential species for aquaculture throughout the South and Southeast Asia including China, Middle East, Africa and South America regions. During 1999 to 2015 there has been a tremendous progress in tilapia farming in Bangladesh. FAO (2016) reported that in 2014, Bangladesh ranked third after China and Indonesia among the top eight tilapia producing countries in the Asia-Pacific region. Production increased from 2,140 tonnes in 1999 to 377,346 tonnes in 2016.

## A large hatchery industry

Meanwhile >400 tilapia hatcheries and > 15,000 small, medium and large commercial tilapia farms have been established all over the country. These hatcheries are producing >5.0 billion monosex fry every year. The majority of these fry are used for commercial farming in the country, and there is a report that >150 million tilapia fry and fingerlings are sold to farmers in the neighboring countries such as India and Nepal. The introduction of the Genetically Improved Farmed Tilapia (GIFT) strain of Nile tilapia (*Oreochromis niloticus*), provided in 1994 by WorldFish (formerly ICLARM) under the Dissemination and Evaluation of Genetically Improved Tilapia in Asia (DEGITA) project and a second introduction in 2005 from Malaysia led to the development and continuous improvement of strains by genetic selection at Bangladesh Fisheries Research Institute (BFRI). This was followed by dissemination of these improved strains and adoption of low cost and appropriate breeding and aquaculture technologies in a large number of tilapia hatcheries and farms. Within a span of 12 years (2005-2015), tilapia production increased more than 19.5 times in Bangladesh, from 19,268 tonnes in 2005 to 377,346 tonnes in 2016 (Figure 1).

Nevertheless, in private hatcheries, repeated use of the same parent population led to poor brood stock management.

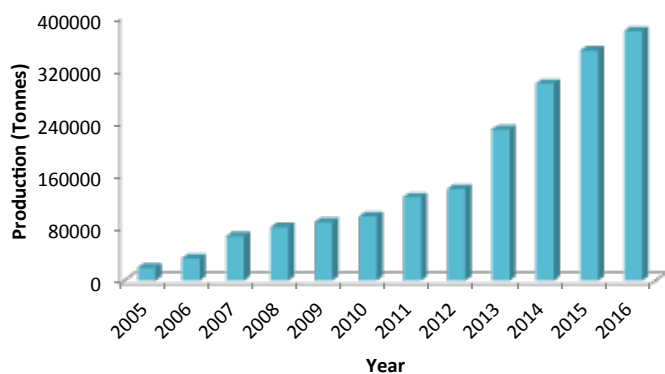


Figure 1. Tilapia production over the last 12 years (2005 – 2016) in Bangladesh

Additionally, no new or poor brood stock replenishment resulted in the production of inferior quality seeds and genetic drift in hatchery population inhibiting sustainable tilapia production. To mitigate the existing situation, during 2005 – 2015, BFRI conducted a well-designed family selection research in BFRI's closed tilapia breeding nucleus and during 2012 – 2016 WorldFish, Bangladesh and South Asia joined to establish and run outdoor Tilapia Breeding Nuclei (TBNs) at private sector tilapia hatcheries in Bangladesh.

## Genetic selection program at BFRI closed nucleus

At BFRI, in a closed nucleus of Nile tilapia (*Oreochromis niloticus*) genetic selection program was conducted to manage genetic gain and inbreeding over the 10 years from the establishment of the founder stocks in 2005 to the latest generation in 2015. In March 2005, the founder stock introduced from Jitra Station, Malaysia through the WorldFish Center to BFRI, which included 300 fingerlings from 30 families (10 fish/ family) of the GIFT strain. During this period (2005 -2015) progeny of each generation were produced (including the assembly of the founder stocks in 2005 and base generation in 2007) from 60 sires and 60 dams. The average harvest body weight of the population was 187g. The survival rate was rather high over the grow-out period of about 6 months (90.4%). In this study, genetic gain was measured as estimated breeding values (EBVs) for each generation of selection. Relative to the base population, the gain achieved after nine generations of selection was 36.6%, averaging 4% per year or generation (Figure 2).

## Maintenance of genetic diversity

The selection program also successfully managed inbreeding to an average rate less than 1% per generation. The population still shows substantial genetic diversity, indicating that family selection effectively increased genetic gain and managed inbreeding in the present population of Nile tilapia in Bangladesh. Hence, there is scope for future selection to improve growth and other traits of economic importance.

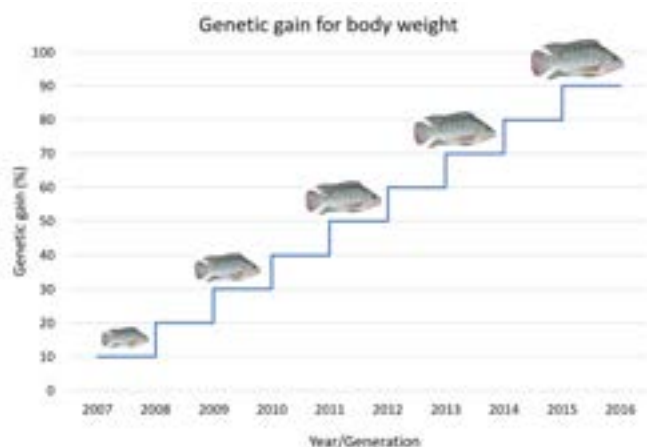


Figure 2. Genetic gain achieved from the selection program for harvest weight in GIFT strain of Nile tilapia at BFRI.



Breeding hapas at a closed breeding nucleus at BFRI, Mymensingh, Bangladesh



Tilapia egg incubation system in a commercial hatchery in Bangladesh

## Outdoor Tilapia Breeding Nuclei (TBNs) of WorldFish

From 2012 to 2016, WorldFish, Bangladesh and South Asia established a number of Tilapia Breeding Nuclei (TBNs) under RFLDC/DANIDA, Aquaculture Income for Nutrition (AIN) and CSISA-BD projects. They used the 11th generation of the improved GIFT strain collected both from Jitra Station, Malaysia and Freshwater Station, BFRI, Bangladesh. A total of seven TBNs was successfully established and run in seven small, medium and large scale commercial private hatcheries in Jessore, Narail, Bagerhat, Barisal, Rangpur and Mymensingh regions of the country. Both selective breeding and rotational breeding techniques have been applied in these TBNs to produce generation wise improved GIFT fry (Figure 3 and Figure 4).

In 2016, a total of 2.36 million improved GIFT fry were produced and distributed/sold from these TBNs among 47 tilapia hatcheries in Rangpur, Jessore, Narail, Fardidpur, Khulna and Barisal regions. In 2017, the target of these TBNs is to produce >3.0 million of improved GIFT fry and distribute among 70 multiplier tilapia hatcheries in southern, northern and greater Mymensingh regions as well as beyond.

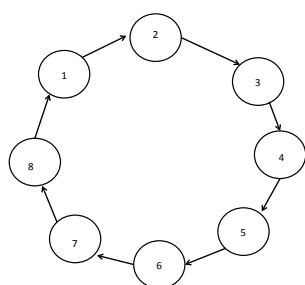


Figure 3. Rotation of males for generation 1, 3, 5 and so on

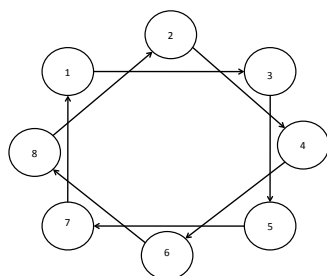


Figure 4. Rotation of males for generation 2, 4, 6 and so on

## Future directions

Both BFRI and WorldFish, Bangladesh and South Asia will continue setting up a number of Satellite Breeding Nuclei (SBNs) in remote regions of Bangladesh to increase both quality and quantity of commercial seed production. Strengthening the genetic improvement program in particularly at BFRI will further promote sustainable production of tilapia in Bangladesh. Public and private hatcheries will act as the multipliers for dissemination of high quality brood stocks to adapt with a wide range of tilapia farming systems of the large group of grow-out farmers in the country. This novel attempt undoubtedly will enable most of the tilapia hatcheries located in all the regions to produce high quality tilapia seeds using these improved GIFT fry/brood stocks for

continuing the sustainable progress of rapid expansion of tilapia farming in Bangladesh. It is expected that tilapia production could increase to 1 million tonnes by 2030 provided overall production system management, genetic selection and effective dissemination pathways remain perfect.

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