

Making a GIFT selection: improved tilapia in the Philippines

Key fact:

A pioneering breeding programme for aquaculture has turned an African fish, previously unknown in Asia, into the favourite source of affordable protein for more than 20 million poor Filipinos and millions more in 13 countries across Asia.

Summary:

Genetically Improved Farmed Tilapia (GIFT) is the product of the world's first selective breeding programme for tropical fish, and has become a template for genetically improving other aquaculture species. The GIFT strain of Nile tilapia grows quickly and survives well, dramatically increasing aquaculture yields. Between 1990 and 2007, tilapia production in the Philippines expanded by 186 per cent, while production costs fell by 32-35 per cent. The Asian Development Bank found in 2003 that GIFT and GIFT-derived strains accounted for 68 per cent of tilapia seed produced in the Philippines and, in the same year, President Gloria Macapagal-Arroyo declared tilapia the up-and-coming "food of the masses".



Genetically improved tilapia
(WorldFish)

The introduction and dissemination of GIFT have generated significant rural incomes and employment, and contributed to human nutrition, especially among the poor, as tilapia is a relatively low-priced fish. Tilapia farming provides an attractive livelihood for hatchery operators and fish farmers and the contribution of GIFT to employment generation has been significant, including for poor smallscale farmers. As many new fish farmers are women, this empowers them while improving local supplies of high-quality, affordable protein, providing an income and benefiting the nutrition of the household.

Facts & figures¹

- ❖ The GIFT project operated from 1988 to 1997 and served as a launching point for tilapia improvement efforts in Asia, as well as tropical finfish improvements globally.
- ❖ Based on the selective breeding of Nile tilapia, the GIFT project succeeded in producing tilapia with faster growth rates, higher survival rates, and a shorter harvest time, thus increasing fish yields dramatically.
- ❖ Between 1990 and 2007, tilapia production in the Philippines expanded by 186%, while production costs fell by 32-35%.
- ❖ In 2003, GIFT and GIFT-derived tilapia strains comprised 68% of total tilapia seed produced in the Philippines and 46% of all national seed production in Thailand.
- ❖ By 2004, 210 participants from 14 Asian, African and Latin American countries had been trained under INGA's (International Network on Genetics in Aquaculture) programmes.
- ❖ 1994-2003 INGA facilitated 70,913 GIFT germplasm transfers amongst member countries.
- ❖ By the end of 1997, a total of 553,350 GIFT fertilised fish eggs had been disseminated to 13 regional outreach stations in South and South East Asia.
- ❖ Between 19.3–22.6 million Filipinos have benefited from GIFT and GIFT-derived strains.
- ❖ In the Philippines, a fish farmer with four cages who harvests tilapia twice a year can earn net returns of US\$3,120 a year. In Northern Thailand, a farmer who farms GIFT in cages as a secondary income source earned net returns of US\$1,236 a year (4 cages, 3 crop cycles a year) (ADB, 2005).

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Dubbed the 'aquatic chicken', tilapia are especially popular with smallscale farmers. In Thailand, for example, tilapia is a major source of protein for the poor costing half as much as other popular freshwater species, such as catfish or snakehead. Relatively unknown in the Philippines until about 25 years ago, tilapia is now the most popular freshwater species for aquaculture.

Mozambique tilapia was first introduced to the Philippines from Thailand in the 1950s as an attempt to provide a cheap source of nutritious food but consumer uptake proved poor. Nile tilapia was then introduced during the 1970s but problems including inbreeding, insufficient fish seed supply, stagnant production and poor fish growth hindered smallscale aquaculture production.



Girl with tilapia, Bangladesh (WorldFish)

It wasn't until the late 1980s that a pioneering project helped to achieve success in breeding improved tilapia strains, which produced significantly increased yields and provided a viable system for poor aquaculture producers. Not genetically modified or transgenic, this new species was bred using traditional selective breeding methods to produce a 'super' tilapia, which was dubbed GIFT (Genetically Improved Farmed Tilapia). This success served as the starting point for tropical finfish genetic improvement around the world.

The benefits of the GIFT strain include significantly faster growth rates than other farmed strains, improved survival in polluted waters and that they can be raised in extensive systems without the need for commercial feeds. For smallscale farmers, the benefit of three fish crops per year, instead of the usual two, raises the yield potential and income generation from the smallest of ponds. Consumers also gain from lower prices as the cost of production falls and supply increases when GIFT fish are farmed locally.

Between 1990 and 2007, with the spread of GIFT and GIFT-derived strains, tilapia production in the Philippines nearly doubled whilst total consumption of tilapia almost quadrupled. The Asian Development Bank found in 2003 that GIFT and GIFT-derived strains accounted for 68 per cent of tilapia seed produced in the country. Today, more than 20 million Filipinos have benefited from the GIFT research conducted by the WorldFish Center (previously ICLARM) and its partners. Poor smallscale farmers are among those that have benefited from employment in tilapia farming and associated activities.

In 2008, WorldFish reported that GIFT had achieved a genetic gain in live weight of at least 64 per cent in the nine generations since the base population was established. As GIFT are around 30 per cent cheaper to produce than non-GIFT fish, smallholders with 1.5 hectares can earn as much as US\$3,100 more per year by switching from ordinary tilapia to GIFT strains as, with faster growing strains, farmers can harvest up to three times per year.

Initially, GIFT trials were conducted in Bangladesh, China, Thailand and Vietnam, as well as in the Philippines. Today, 13 countries in Asia have received GIFT to develop national breeding and dissemination programmes and GIFT's fast growth and high yield has encouraged many rural families to take up environmentally friendly aquaculture across the region. As many

new fish farmers are women, this empowers them as it improves local supplies of high-quality, affordable protein and benefits the nutrition of the household.



Harvested genetically improved tilapia (WorldFish)

Genetic improvement technology developed and applied by the WorldFish Center and its partners has since been expanded to carp (the most widely farmed fish group in Asia), African catfish (*Clarias gariepinus*), and it is being further developed for freshwater prawn (*Macrobrachium rosenberghii*).

Despite the success of the project, the researchers involved concede that it is easier to breed an improved strain than it is to disseminate the strain and achieve impact. Delivering impact requires influencing people and the way they operate, which must be done in a manner that is

compatible with the social and economic circumstance of each country - and, often, of a region within a country. However, WorldFish has found that the availability of an improved fish strain acts as a powerful incentive for farmers to adopt better aquaculture practices in other areas, such as feed, management and marketing.

With the continued focus on poor smallscale farmers, maintained by WorldFish, the GIFT project produced an affordable and resilient fish that has raised incomes and contributed to human nutrition, meeting the needs of millions of poor consumers through much of Asia. The successful model developed for GIFT has also become an invaluable template for genetically improving other aquaculture species.

Table 1. Examples of indicative net returns from farming GIFT in 2003 (ADB, 2005)

Source and unit of measure	Philippines Pesos (P)	US\$ (a)	Thailand Baht (B)	US\$ (b)
Hatchery (per ha/year)	275,000	5,074	200,000	4,819
Growout pond (per ha/crop)				
4-month crop cycle	101,188	1,867	n/a	n/a
6–6.5-month crop cycle	n/a	n/a	74,000–137,000	1,783–3,301
8-month crop cycle	n/a	n/a	176,000	4,241
Growout cage (per cage/crop)				
Cage size 10 × 10 × 10 m (5–6-month crop cycle)	21,119	390	n/a	n/a
Cage size 3 × 6 × 2.5 m (4-month crop cycle)	n/a	n/a	4,285	103

a US\$1 = P54.2

b US\$1 = B41.5

Note: cage sizes and stocking rates vary, and the total household incomes depend on the number of cages operated (Source: key informant interviews and surveys)

Additional case study information

Costs and benefits:²

- The implementation of a genetic improvement programme with Nile tilapia required an initial investment in the order of US\$60,000 to US\$90,000, and incurred a recurrent annual cost of the same magnitude.
- A study conducted by Ponzoni et al. (2007) found that the national economic benefit derived from a genetic improvement program such as GIFT was extremely favourable. Even with ponds operating with moderate efficiency, the economic benefit of such activities was valued at over US\$4 million, while the benefit-cost ratio was 8.5.
- With more elaborate but practical reproduction techniques (e.g. using artificial incubation) the benefit-cost ratio more than doubled.

DFID contribution to research:

- Support to the GIFT project during the transfer of the strain from the Philippines to Malaysia, while the WorldFish Center was being set up.
- Upgrading of facilities at the Department of Fisheries, Malaysia research station in Jitra, Kedah State were made possible.
- Much of the research and development required to consolidate in Jitra what is now the nucleus (best population) of the GIFT strain.
- Specific research areas including the estimation of genetic change in the GIFT population and the production of all-male tilapia by alternative methods.
- DFID provides ongoing core-funding to WorldFish.

Research milestones:

- 1988 GIFT project is launched in the Philippines.
- 1993 Scientists produced three generations of offspring which were growing much faster and exhibiting higher survival rates than local tilapia strains.
- 1993 INGA established.
- 1994 Improved tilapia strains first disseminated through trials conducted at stations and farm environments within five member countries (Philippines, Bangladesh, China, Thailand, and Vietnam).
- 1997 The GIFT project had bred nine generations of fish.
- 1999 Donor funding for the GIFT project ends and GIFT Foundation International is established to continue breeding and outreach efforts.
- 1999 GIFT Foundation International enters into an agreement with GenoMar, a private Norwegian biotechnology company, for dissemination rights of GIFT, which is re-branded GenoMar Supreme Tilapia (GST™).

Photo credits:

WorldFish Center: For high res images contact Florine Lim (f.lim@cgiar.org)

Multi-media materials:

<http://www.techawards.org/2005Videos/Worldfish.mov>

TVE Hands on clip from BBC World

http://www.worldfishcenter.org/resource_centre/GIFT_From_Africa.rm

Links:

WorldFish Center: www.worldfishcenter.org

International Network on Genetics in Aquaculture:

<http://www.worldfishcenter.org/inga/index.htm>

Main references:

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Yosef, S., (2009) *Rich food for poor people: Genetically improved tilapia in the Philippines*, IFPRI Discussion Paper 00925

<http://www.ifpri.org/sites/default/files/publications/ifpridp00925.pdf>

Other key references:

Khaw, H.L., H. Bovenhuis, R.W. Ponzoni, M.A. Rezk, H. Charo-Karisa, and H. Komen, (2009) Genetic analysis of Nile tilapia (*Oreochromis niloticus*) selection line reared in two input environments, *Aquaculture*, 294: 37-42

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http://www.worldfishcenter.org/resource_centre/WF_968.pdf

Ponzoni, R.W., N.H. Nguyen and H.L. Khaw, (2007) Investment appraisal of genetic improvement programs in Nile tilapia (*Oreochromis niloticus*), *Aquaculture*, 269: 187-199

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http://www.worldfishcenter.org/resource_centre/WF_1640.pdf

Contact for further information:

Dr Raul W. Ponzoni

Principal Scientists and Project Leader (Geneticist)

Aquaculture and Genetic Improvement

The WorldFish Center

PO Box 500 GPO

10670 Penang

Malaysia

Tel: +604 6202159

Fax: +604 6265530

Email: r.ponzoni@cgiar.org

¹ Unless indicated otherwise, facts and figures sourced from: Yosef, S., (2009) *Rich food for poor people: Genetically improved tilapia in the Philippines*, IFPRI Discussion Paper 00925

² Ponzoni, R.W., N.H. Nguyen and H.L. Khaw, (2007) Investment appraisal of genetic improvement programs in Nile tilapia (*Oreochromis niloticus*), *Aquaculture*, 269: 187-199



DFID, the Department of International Development, is the part of the UK government that manages Britain's aid to poor countries and works to get rid of extreme poverty.



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