

CARP GENETIC IMPROVEMENT PROGRAMS

WorldFish initiated the Carp Genetic Improvement Program in 2012, with financial support from USAID through the Aquaculture for Income and Nutrition (AIN) project. The program has continued through the USAID-funded Feed the Future Bangladesh Aquaculture and Nutrition Activity. Other support came from IFAD and the CGIAR Research Program on Fish Agri-Food Systems (FISH).

Methodology

In 2012, seed from three wild rohu and catla stocks was collected as spawn from the Halda, Jamuna and Padma rivers during the carp-breeding season and reared until maturity. Meanwhile, silver carp brood stock was collected from a number of private and public hatcheries across Bangladesh. The main methodology is to develop families of known parentage that can be crossed, with the aim of increasing performance while retaining genetic diversity. All breeding fish are tagged with passive integrated transponder (PIT) tags so they can be identified. Individual fish in each family are monitored in growth trials, and the crossing pattern for the next generation is determined based on their performance.

For rohu, the progeny from original brood stock resulted in 210 families of fry that were grown to taggable size (>5 gr) in hapas. Trials were carried out to determine whether fish performed differently in



Hapa nursing facilities in the research station



WorldFish Bangladesh Carp Genetic Improvement Programs

polyculture or monoculture and to estimate the heritability of growth rate improvement. These trials determined that there was little difference between culture systems and heritability was high.

After two years, the fastest growing fish were selected from each family to form the first generation of the improved line. First-generation PIT-tagged rohu were cultured in eight ponds with natural and supplementary feeding in mono- and polyculture systems. These fish were bred in 2018 to produce 240 families of the second generation. Each family was individually reared in fine-meshed nylon net hapas in ponds up to PIT-taggable size (by the end of 2018), when they were be tagged and reared in communal ponds. The plan is to disseminate the improved strain to hatcheries when there is a significant level of improvement. This is expected to be in the third generation.

The genetic improvement of catla followed a similar protocol. However, poor breeding success in 2016 delayed the development of the first generation until 2017, when 237 families were produced. PIT-tagged fingerlings from these families are currently being grown in mono- and polyculture ponds to quantify genotype by environment interaction in growth and survival.

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Panoramic view of Rohu Genetic Improvement Program

In 2015, fin clip samples of silver carp, bighead carp and their hybrids were collected to develop genetic tools to identify silver-bighead hybrids. Founders of the breeding population were also collected from the public and private hatcheries. The founder fish were fin clipped and the clips were used to generate molecular markers. These were subsequently used to verify the purity of silver carp founders and generate a genetic distance matrix. The spawn of 225 base population pure silver carp families were grown in *hapas* from April to October 2017 until the fish reached >10–15 gr in size. Fifty fingerlings from each of the families were PIT tagged and have been stocked in mono- and polyculture ponds in Jashore to quantify genotype by environment interaction in growth and survival.

Significance of the Carp Genetic Improvement Program

The Carp Genetic Improvement Program is the only program of its kind in the world concentrating on catla and silver carp as well as being the largest family-based selection program for rohu. The methods are similar to those used to develop faster growing chickens and livestock that have transformed their respective sectors. Growth should improve by around 10 percent in each generation. However, the time taken from spawning to breeding is two years for rohu and silver carp and three years for catla. As a result, it will take six to nine years to develop the third generation of elite strains with growth rates at least 30 percent faster than the base population.

Once elite strains of rohu and catla are available for use in hatcheries, there will be less pressure on wild stocks through seed collection from rivers. The provision of pure strain, fast-growing silver carp will particularly benefit resource-poor farmers, enabling them to produce more fish from fertilized ponds and water bodies.

Longer term sustainability of the Carp Genetic Improvement Program will most likely depend on collaboration with private sector fish breeding companies combined with oversight by regulatory authorities. As long as the program continues, the performance benefits will continue to accumulate. More recently, the use of genomics is allowing for selection of more sophisticated traits, including resistance to disease, taste or performance at high or low temperatures.



Biomark PIT Tag inserting in Rohu

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