How Genetic Breeding Program Can Fit with an Ecological Intensification Approach for small scale fish farming?

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In intensive aquaculture systems, genetic improvement programs are playing an important role in increasing fish productivity. As an example, 80 % of the total European aquaculture production originates from selective breeding (Janssen et al, 2017). Although the proportion of genetically improved stocks is increasing worldwide, above 90% of the global aquaculture industry was still based on wild and non-domesticated fish in 2010 (Gjedrem, 2012). Genetic improvement has the potential to increase efficiency and sustainability of the aquaculture production, even in extensive systems.

Until now, the genetic breeding programs were mainly developed in intensive systems in which the environment is relatively well controlled. Improved fish are selected at least for growth but generally also for other traits of interest, such as disease resistance or fillet yield. Using these genetic approaches, it is particularly complex for small and medium stakeholders to develop a breeding program for their fish with an ecological intensification approach. Consequently, the main question to ask is how breeding program could be adapted to allow an ecological intensification of fish production for small and medium farmers?

A lot of challenges must be met to develop such a program. Here is the list of some major ones: 1/ the cost of a breeding program can be extremely expensive depending on the traits of interest included in the breeding goal, 2/ these traits need to be measured accurately on a large number of fish, 3/ the number of fish to breed for the next generation must be high to reduce inbreeding but not too high to get a sufficient selection intensity by selecting only the best fish, 4/ the rearing environment need to be taken with care.

One solution could be to develop a participatory breeding program. Theoretically, rather than having a breeding program in a single place, it could be better to meet together a large number of small and medium stakeholders. Each of them could have a small number of parents and measure accurately a small number of fish. At each generation, the best individuals used as parents for the next generation could be exchange with other farmers involved to reduce the inbreeding.

By this way, the all group of participating farmers will keep a large genetic variability of the fish population involved in the breeding program. In addition, whatever the trait under direct selection is, an indirect selective breeding for robustness will occur, because each farmer will rear the fish with his own conditions leading to the selection of adapted fish that cope well in the various rearing environments.

Even if a lot of questions are still raised, the first one being obviously whether a visible improvement can be observed and in how many generations, a potential is existing for such program in several countries where an intensive breeding program are not answering to the fish farmer requests, which is the case for example in Madagascar where tests will begin shortly.

Gjedrem, T. (2012). Genetic improvement for the development of efficient global aquaculture: A personal opinion review. Aquaculture 344–349, 12–22.
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