

Vietnam: Stock comparisons for polyculture and national breeding programmes

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The government of Vietnam has formulated a Fisheries Master Plan to Year 2010. The national objective for fisheries and the fishing industry is to contribute effectively to the improvement of the national economy and the social and socio-economic conditions of the people. The Fisheries Master Plan includes a component on maximizing the economic contribution from aquaculture habitats. This component aimed to ensure that the natural resource potential for aquaculture would be realized in an effective and sustainable manner in support of economic development and growth and food security. One of the important broad based operational strategies for achieving this aim was to increase production of fish from freshwater aquaculture for both domestic and export markets. A major emphasis of aquaculture production is reflected in the Aquaculture Seed Development Programme, prepared by the Ministry of Fisheries (MOFI) in 1999. This Programme aims to promote the expansion of fish hatcheries, improving hatchery technologies in the commercial sectors to expand and improve the production of quality fish seed.

An important component of the Aquaculture Seed Development Programme is the formation of three National Broodstock Centers (NBCs), the proposed functions of which are shown in Box 1.

Box 1 The objective of the NBCs is the production of high quality broodstock and preservation of fish genes. This can be achieved through implementation of a number of key activities:

- The application of good broodstock management practices and genetic improvement programmes to maintain or improve the quality of commercially important cultured freshwater species
- The production and distribution of quality broodstock to hatcheries with initial emphasis on provincial hatcheries
- The production and distribution of fish seed to some growers
- The maintenance of gene banks for the most important freshwater fish species
- The development and demonstration of advanced hatchery technology
- The production of training and extension material and the training of fish seed producers

The Vietnamese component of the research project on the Genetic Status and Improvement of Exotic Carp for Low-input Aquaculture in Asia has the following objectives in support of the NBCs.

1. Development of methodologies for conducting on-station and on-farm stock comparison in carp polyculture illustrating effective optimisation of resources (compared to conducting comparisons of single species).
2. Rational choice of stocks for optimised production in low-input aquaculture systems, namely lowland and upland rice-fish culture, sewage-fed fish culture and integrated VAC systems.
3. Estimates of heterosis in crossbreds of these species, which would be expected to result in recommendations for the adoption under culture of one or more crossbred genotypes.
4. Quantifiable estimates of the potential production and economic gains (including in a livelihood context) of adoption of “improved” polyculture systems and of “best” stocks, compared to existing polyculture and traditional low input systems.

5. The formulation of recommendations on the choice of stocks, the management strategies and the further genetic improvement of these aquaculture stocks.
6. The creation of a live and cryopreserved (sperm) gene bank of base stocks available for carp aquaculture in Vietnam, duplicated at AIT.

Progress to date in the project includes the assembly of live gene banks of available stocks including the importation of new stocks of key species. Species on which the project focuses includes Chinese carp, silver carp and grass carp, the Indian major carp mrigal and rohu together with common carp and silver barb. In particular new introductions of silver and grass carp have been made from China and of Indian carp, rohu and mrigal, directly or indirectly from India. Protocols have been developed for the simultaneous evaluation of up to four stocks per species under polyculture in both on-station and on-farm environments (representing all of the aforementioned low-input aquaculture systems). Early results from the first year of growth trials indicate superior culture performance of newly introduced stocks of rohu (from India via Thailand) and grass carp (from China) compared to locally cultured stocks. However the opposite was true in the case of silver carp, possibly due to introgression of the introduced stock with an indigenous sub-species thought to have existed in Vietnam.

In addition, sperm cryopreservation protocols developed and optimized for common carp have been found to be effective for grass carp and mrigal and are likely to be effective across all the species on which the project is focused. Cryopreserved sperm gene banks have been initiated to supplement the live gene banks for grass carp and mrigal and these will be extended to include rohu and silver carp in the coming year.

The Vietnamese component of the exotic carp genetics project originally focused on the Indian and Chinese major carps and did not include any significant component on common carp. Since the project was initiated however, there has been a growing interest in the status and potential of “indigenous” common carp which are the mainstay of traditional rice-fish culture systems practiced by the indigenous people of the mountainous regions of northern Vietnam (extending into Laos and southern China). These mountain ranges have some of the poorest communities in the country due in part to their isolation from the mainstream economy (Little and Tuan, 1999). Under Programme Development funding from the (then) DFID Fish Genetics Programme, a survey was conducted of the role of indigenous common carp in these traditional culture systems, which included field research into the ancestry and genetic management of the stocks. The context in which the study was conducted was that government agencies, mainly the Research Institute for Aquaculture No. 1, were promoting and widely distributing an improved common carp strain derived from selection applied to a population derived from a native Vietnamese stock and

stocks introduced from Hungary and Indonesia. Given the particular characteristics of the traditional upland rice-fish culture systems, it was not clear whether this improved strain would be most appropriate for these systems and furthermore, whether the indigenous stocks, that could be threatened by the widespread introduction of an improved strain, were in fact valuable genetic resources, particularly for these poor communities. The resulting outputs from this Programme Development research (Mair, 2000; Edwards *et al.*, 2000) painted an interesting picture. The outputs from this research, elements of which were subsequently integrated into the Vietnamese component of this project were:

- A report highlighting the major socio-economic and environmental impact issues related to the introduction of carp polyculture and in particular improved strains of common carp into regions where traditional rice-fish aquaculture is practiced.
- An article highlighting important issues from the report published in World Aquaculture magazine
- A live gene bank of common carp stocks available in northern Vietnam.
- The creation of a cryopreserved sperm gene bank of common carp stocks in northern Vietnam
- Initial recommendations on the appropriate policy and management of stocks of indigenous common carp in northern Vietnam

The main policy elements and recommendations derived from this study are shown in Box 2.

Some major properties of indigenous carp, largely derived from a genetic adaptation to these particular systems over many generations, included residence in the rice field (whereas other stocks often escaped), low incidence of disease and higher market price. It was however evident that the growth rate and productivity of these stocks was low, particularly when compared with the selectively improved RIA#1 strain. Based on information on the long-term management of the stocks of indigenous stocks, it was evident that most were maintained within farms, or groups of farms, as reproductively isolated populations and thus subject to genetic forces of inbreeding, genetic drift and unconscious selection. Inbreeding and genetic drift may have contributed to their relatively poor growth rates whilst unconscious selection may have acted as the mechanism behind the development of their advantageous adaptive properties.

Box 2. Policy implications and recommendations derived from a study of the role of indigenous common carp in traditional upland rice-fish culture systems of northern Vietnam

- There is a need for more detailed surveys of current practices and distribution of traditional rice /fish culture systems, and new species and culture systems, in particular their relevance for poor farming households
- There is a need for on-station and on-farm research into the biology (reproduction, nutrition) and growth of local common carp stocks in rice fields and ponds, with characteristics of relevance for the resource base of poor farming households
- Local common carp may have significant benefits for culture in traditional rice/fish systems despite what may be poor growth rates
- Undisturbed populations of local stocks should be identified and preserved through habitat conservation and gene banking
- The role of indigenous common carp stocks in traditional systems and their importance to poor households should be characterized before the introduction of “improved” strains or culture systems
- The inclusion of local stocks should be actively considered in genetic improvement programs developing strains for low -input rice/fish systems, which should consider such traits as retention in the fields, disease resistance and adaptation to shallow water

In accordance with the recommendations outlined above, stocks of indigenous common carp have now been included in farm trials and gene banking activities being carried out under the exotic carp genetics project (R 7590). Performance data, initially of the pure stock but at a later stage of crosses between them, will provide some useful data on which to base future management decisions. Results from data collected to date, after up to 120 days of grow out, show that survival of the indigenous stocks was superior to that of the RIA #1 selected carp during nursing on-station. However, growth of the selected strain was superior to all indigenous stock during nursing and subsequently during grow-out both on-station and in all four low input aquaculture environments. It was noted however that the superiority of the

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selected strain is lowest in the upland rice-fish culture systems to which the indigenous carps are adapted.

A supplementary project has now been proposed to extend the research work to include genetic characterisation of the indigenous carp stocks to provide further data to better inform future decisions on the management, exploitation and conservation of these potentially very important fish stocks. One potential application of these data is that if it shown that poor growth rates are associated with low levels of genetic variation within farm stocks, due primarily to inbreeding, it may be possible to improve growth performance of these stocks by outbreeding or crossbreeding them, whilst retaining their important adaptive properties. In the context of the current and future livelihoods of households operating these traditional systems such management decision could be of considerable importance.

References

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