Case studies

Aquaculture in the Mekong basin: alien or indigenous species?

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Preliminary estimates of the relative profitability of alien vs. indigenous species in small-scale aquaculture indicate that some indigenous species are already economically viable despite the lack of progress in domestication

Extension of aquaculture techniques in the lower Mekong basin has in the past promoted alien species, which has led to alien species currently dominating small-scale aquaculture. The reasons for this included a general lack of knowledge on the biology of indigenous species and the associated absence of domesticated aquaculture strains. Therefore, using established alien aquaculture species was expedient since seed production and culture systems could easily be extended without the need for much additional research. By importing suitable strains the domestication process could be bypassed. Further, alien species were often perceived as more profitable for small-scale farmers.

The Mekong Basin is endowed with a rich fish fauna, estimated to consist of at least 1 200 species, and possibly as many as 1 700 (Coates, Ouch, Suntornratana, Tung, & Viravong, 2003). It is reasonable to assume that such a diverse fish fauna should include many species suitable for aquaculture. In fact, several indigenous species are already used for aquaculture, although generally at a basic level of domestication. Seed for some species groups, e.g. Pangasidae and Channa spp., are often collected from the wild (Van Zaalinge, Lieng, Bun, Kong, & Valbo-Jørgensen, 2002).

Aquaculture is one of the main reasons for introduction of alien species to aquatic ecosystems. As much as 17% of the global aquaculture production is contributed by introduced species (Bartley & Casal, 1998). Information on environmental impacts of alien aquatic species is scattered and difficult to find, but efforts are underway to improve the availability of such information, including the DIAS database maintained by FAO (http://www.fao.org/fi/statist/fisoft/dias/index.htm and http://www.fao.org/fi/figis/Introsp/index.jsp). FishBase (http://www.fishbase.org) also includes information on introductions.

Aquaculture of Indigenous Mekong Fish Species

Developing domesticated strains from wild fish for aquaculture purposes is time consuming. Current efforts to amend the situation include the MRC Fisheries Programme Component AIMS (Aquaculture of Indigenous Mekong fish

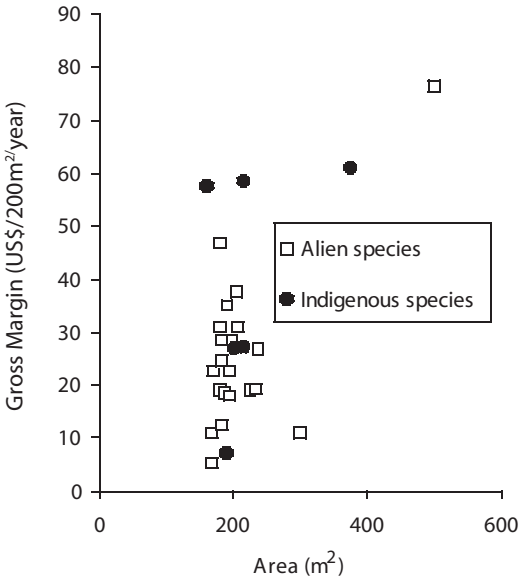
Species). The rationale for the Component is that the use of alien species will only decrease when suitable, economically viable indigenous alternatives are available. Preliminary estimates of the relative profitability of alien vs. indigenous species in small-scale aquaculture indicate that some indigenous species are already economically viable despite the lack of progress in domestication (Figure 1).

The Component supports the Fisheries Departments of Cambodia, Lao People's Democratic Republic, Thailand and Viet Nam to carry out research and development toward improved culture systems for indigenous species. AIMS cooperates with 11 aquaculture stations in the region. The current priority species are *Anabas testudineus, Barbonymus gonionotus, Cirrhinus microlepis, Cirrhinus molitorella, Leptobarbus hoevenii, Hemibagrus wyckioides, Osphronemus exodon, Pangasius bocourti* and *Pangasianodon hypophthalmus*.

Benefits from alien species

The introduction of alien fish species has brought considerable benefits to small-scale farmers. For example, tilapia culture has been successfully developed in the region, largely because it can be easily bred. This has made seed widely available, even in remote areas. Tilapia is also used in commercial aquaculture, but these operations depend on more domesticated strains with higher growth rates, which require more sophisticated propagation methods and rely on high grade, expensive feed.

Figure 1. Estimates of relative profitability of small-scale pond culture in Cambodia. Gross Margin = Revenue – Variable Costs (labour included), i.e. excluding Fixed Costs. Culture ponds were generally stocked with several species (poly-culture). Part of the data kindly provided by AIT (Cambodia) and READ (Cambodia).



Risks with alien species

One important risk with introductions of alien species is that they may be 'invasive', thus tending to spread prolifically and harmfully in the environment. Once an aquatic organism is established in a system like the Mekong, the introduction is essentially irreversible. In Cambodia, at least, there are a couple of examples where tilapia populations have almost entirely replaced the indigenous fish species (Nouv, Viseth, & Ouk, 2003). However, in recognising the obvious risks with alien species, it is equally important to consider that almost all domesticated plants and animals that humans use are actually alien to most areas, but even so they are generally not considered invasive. Import of new diseases is another major risk associated with introductions. Information on impacts of introductions of aquatic organisms in the Mekong basin is reviewed by (Welcomme & Vidthayanon in press).

NEED FOR A BALANCED APPROACH

The properties of an organism that determine whether it becomes invasive or not in a particular environment and/or at a particular time are highly complex. Adverse effects may not be immediately apparent, but may surface years or decades following the initial introduction. Further, the taxonomy and distribution of many aquatic species in the tropics are not well known, so the ability to even assess pre-introduction biodiversity is very limited. Therefore, accurate prediction of potential environmental effects from an introduction is extremely difficult. Decisions whether to introduce an organism or not are often based mainly on empirical evidence from other areas where the same or similar organisms have been introduced. Further complicating the issue is that if the environment itself comes under sufficient stress, even some indigenous species may behave as invasive nuisance organisms. Thus, there is a need for a holistic, balanced approach, which considers not only the organisms to be introduced, but also the general environmental configuration as well as temporal effects.

Risks with indigenous species

Although there is general consensus that aquaculture using indigenous species poses less risks than using aliens, release or escape of domesticated strains of indigenous species into the wild poses a threat to biodiversity. Aquaculture organisms, except perhaps in highly controlled recirculating systems, sooner or later escape to the wild. This may be due to e.g. flooding of ponds or breaking of cages. If the local wild population of the indigenous species is large and the environment is intact, limited escapes may have negligible impact. However, if the local population is small and/or the local environment is under stress, there may be considerable effects, including modification of the genetic composition of the wild population.

In his Ph.D. dissertation, Wongpathom Kamonrat showed that 75-96% of *Barbonymus gonionotus* samples from the Chao Phraya River, Thailand, were from hatchery populations (Pongthana, 2001). The main reason for this genetic contamination is an extensive fisheries enhancement programme, that every year releases large numbers of fingerlings of this species. In addition, the Chao Phraya river ecosystem is degraded due to a multitude of dams and other sources of environmental stress. Thus, it is likely that the natural recruitment is much reduced (hence the need to stock the river in the first place).

To reduce risks, there is a need to clearly distinguish between seed production for aquaculture and for fisheries enhancement. The characteristics and genetic composition of fish seed desired by aquaculture is quite different from what is required for release into the wild. The former calls for highly domesticated strains selected for e.g. growth and disease resistance, whereas the latter must be genetically as close to the local wild population as possible. For enhancement purposes, breeding should, wherever possible, be based on locally caught, wild brooders.

Management units

Many fish species in the Mekong form sub-populations, which may be separated by e.g. geographic distances or using different spawning grounds etc (Poulsen, Poeu, Viravong, Suntornratana & Tung, 2002). To enable rational management of aquaculture of indigenous species, it is recommended to establish species specific management units, which define the genetically distinct wild sub-populations of the cultured species, and thus provide a framework for determining how fish may be moved within the basin without causing undue risks to local populations.

Conclusions

Indigenous fish currently used in, or being developed for aquaculture in the Lower Mekong Basin:

- have a high market demand and value
- are usually preferred by farmers
- show variable but generally comparable growth to aliens
- are likely to have a high potential for improved strains through selection

The development of aquaculture based on indigenous species will cause fewer environmental concerns.

Good broodstock management is key to progress and to avoid potential pitfalls.

Some indigenous fish species will most likely provide viable (economically and otherwise) alternatives to alien species.

Any movement of indigenous (as well as alien) fish species must be controlled and properly considered before being carried out; such control may be facilitated by establishing management units.

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