Small-scale fish culture using indigenous fish species in Takeo and Prey Veng provinces of Cambodia

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1. Abstract

Small-scale aquaculture in rural areas can contribute to increased food security for poor people. In the Mekong River Basin, the dominant aquaculture species are exotic species such as Tilapia, Chinese carps and hybrid species. When these species escape from fishponds to natural water bodies they may pose several risks to the environment and to indigenous species, including: food and habitat competition, predation, genetic interference and disease contamination. This may lead to the decline of native species.

A study of aquaculture with indigenous fish species was conducted in Takeo and Prey Veng provinces of Cambodia. The objective of the study was to investigate whether indigenous fish species can replace or complement exotic species in small-scale aquaculture.

A survey was conducted with 28 farmers (type 1) who stocked their ponds with 5 indigenous fish species and 14 farmers (type 2) who stocked with a mixture of indigenous fish and exotic fish species. The results showed that the total fish yield from type 1 was 35 kg/100m^2/8months and from type 2 it was 42 kg/100m^2/8months. The pond input, especially rice bran was very high: 190 kg/100m2/8months, compared with only 70 kg/100m2/8months used by the READ Component (READ, 2000). However, some positive result was that the growth of *P. hypophthalmus* and *B. gonionotus* was very high when they were stocked together with other indigenous fish species. And high market demand for indigenous species could help farmers to get high profit (51-58%). Some indigenous fish species (*B. altus* and *T. pectoralis*) are not recommended. Farmers were generally happy with the results and only two farmers decided to stop culturing any of these species.

In conclusion, small-scale fish culture with indigenous fish species is feasible for rural farmers and could possibly be used to replace aquaculture with exotic species. However, studies should be continued several more years in order to get standard results and develop culture techniques.

2. Introduction

The Mekong River is one of the world's largest rivers, with possibly the largest inland fishery. Aquaculture contributes around 10% of the total fish production. Exotic species dominate in aquaculture, especially the Indian and Chinese carps, Tilapia and African catfish. At present, exotic species can be found in the natural water bodies, including Tonle Sap Great Lake and the Mekong River (Vibol *et. al*., 2001).

Exotic animals are defined as "species occurring outside of their natural range". Among numerous reasons for the introduction of exotic aquatic animals, aquaculture development is said to be a main motive. Introductions of exotic species and movements of large quantities of fish for stocking are accompanied by risks to the environment, the possibility of native fish species declining through feed and habitat competition, predation or genetic interference, and likelihood of spread of disease (Welcomme et al., 2000). The present impact of introduced species in the basin appears relatively minor. Welcomme (2000) mentioned that *Oreochromis mossambicus* is causing local nuisance in the Mekong delta. There are some suggestions that hybrid *Clarias* are contributing to the decline in the native *Clarias batrachus* and that established populations of *Labeo rohita* may damage native species of the same genus.

In Cambodia, the exotic species have mostly been introduced for small-scale aquaculture in ponds. The Tilapia is the major exotic fish species, followed by Chinese carps, which have been introduced in fishponds in some provinces. They are well adapted to the pond environment. However, fishponds are frequently flooded and the exotic fish stocked in the ponds escape into the natural water bodies and pose risks to the environment.

The native fish fauna of the Mekong is extremely rich and diverse. The introduction of native species into aquaculture might reduce the risks caused by exotic fish species. The native species may adapt well to a wide range of environments both in impounded water and modified flows.

The FAO Technical Guidelines for Responsible Fisheries, Aquaculture Development (FAO 1997, p22) states the following on the use of indigenous (native) species:

"*Native species are often promoted as alternative to introducing exotic species for aquaculture development ... However, native species taken from the wild and domesticated or subjected to other genetic modifications may also pose a risk to the remaining wild stocks, both from genetic and disease standpoints.*"

At present, the introduction of indigenous fish species in aquaculture is being considered by the Department of Fisheries, Cambodia, in collaboration with MRC and other international organizations. With the MRC Fisheries Programme Component Aquaculture of Indigenous Mekong Fish Species (AIMS), a study on introduction of indigenous fish in aquaculture was carried out in Takeo and Prey Veng provinces. The objective of the study was to investigate whether the introduction of indigenous fish in aquaculture could complement or replace exotic fish. This paper describes some of the results of this study.

3. Data collection

The study was conducted in Prey Veng and Takeo provinces in collaboration with PRASAC (Support Program for the Agricultural Sector in Cambodia), Prey Veng, and the READ (Rural Extension for Aquaculture Development in the Lower Mekong Basin) Component of MRC Fisheries Programme. The study included 28 ponds, which

were stocked with mixed indigenous fish species (type 1), and 14 ponds which were stocked with a mixture of indigenous and exotic species (type 2) (Table 1).

Table 1: Number of fishponds and their location

Province	District	Commune	Number of fish ponds (type 1)	Number of fish ponds (type 2)
Takeo	Tram kok	Tropiang Thum	4	6
		Tbong	2	2
		Samrong	3	0
		Tropiang Thum Cheung	1	1
Prey veng	Baphnom	Cheang Tong	2	0
			1	0
		Rong Damrey	7	0
	Prey Veng	Rakchey	1	0
		Beung Pras	0	1
		Damrey Pourn	0	1
	Kamchay Mea	Peanrong	2	0
	Sithokandal	Svay Antor	1	0
	Prasdach	Trabek	2	1
		Romlech	0	1
	Kampong	Chey Kampot	1	0
	trabek	Lovea	1	1
		Prasat Chrey		
Total			28	14

Remark: - Type 1: type of fishpond that was stocked with mix indigenous fish only
- Type 2: type of fishpond that was stocked with mix indigenous and exotic fish

The data was collected through a questionnaire and some secondary data that was collected by other organizations or projects have also been used to evaluate the growth and production of indigenous fish cultured in the fishponds. During the culture period the stocked fish were sampled every two months and information on feed, fertilizer and other activities were collected using record books.

4. Results

Most family household heads were male for both types of culture system. The result from the data analysis showed that 93% of the household heads involved in aquaculture with mix indigenous were male and only 7% of the total were female. For type 2, aquaculture with indigenous and exotic species, the male of household head was 71% and female was 29%.

Age of the household head for both types was the same ranging from 27 to 63 years, with an average age of 42 and 46 years, respectively. Most family members contribute to the activities of fish culture. The average number of family members in a family for

both types was 6 persons but some families have up to 9 persons. Table 2 shows the average age of household heads and average number of person in a family.

Table 2. Average age of household head and average number of people in a family

	Age of household head (year)		Family member	
	Type 1	Type 2	Type 1	Type 2
Average	46	42	6	6
STD	10	5	1	2
Max	63	51	9	9
Min	27	32	3	3

5. Land and rice yield

The main occupation of the people living in the rural area is rice cultivation. Secondary occupations are: animal husbandry, gardening, fishing, fish culture and paid work (e.g. working as government officers). Farmers in rural areas own land for rice cultivation. The fish farmers who cultured indigenous fish own 1.56 ha of land on average and the farmers who cultured mixed indigenous and exotic species own 1.13 ha. The rice cultivation is rain-fed, so that the total rice production is still very low, e.g. within the range of 1637-2000kg/ha/year.

6. Pond size

Fishponds in both culture systems have been selected based on the pond size and location. Generally, the most suitable size of a fishpond for small-scale aquaculture is within a range from 150 to 300 m^2. With this size the fish farmer has the ability to manage and control fish culture properly. However, the actual size of some fishponds in the rural area is much bigger, in some cases up to 1000m^2.

The results of the survey shows that the average size of fishponds stocked with mix indigenous species are bigger than with mix indigenous and exotic fish (264m^2 and 176 m^2, respectively). The average pond depth of the type 1 was significantly larger than type 2 (2m in type 1 ponds and 1.66m of type 2 ponds).

7. Pond Preparation

Prior to stocking fingerlings, lime, organic and inorganic fertilizer, and green manure were used to prepare the fishpond. Cow manure is the main manure that all farmers used to fertilize fishponds. The farmers cultured indigenous fish using lime and fertilizer in the same way to prepare the fishpond and to make the water green. The amounts of lime and fertilizer for pond preparation was 7kg/100m^2 of lime, 2kg/100m^2 of Urea, 1kg/100m^2 of DAP, 36-50kg/100m^2 and 30-40kg/100m^2 of green manure. These amounts are within the range of usual technical recommendations.

8. Stocking

5 main indigenous fish species were selected by fish farmers to stock in their fishponds. They were *Pangasianodon hypophthalmus, Barbodes gonionotus, Barbodes altus, Leptobarbus hoeveni* and *Trichogaster pectoralis*. All these indigenous fishes were produced at the Bati and Chrang Chamres station. All species were stocked from September to October 2001. The stocking ratios, which have not been tested at the fish stations, but used for the first time in these trials, were as following below:

- *Pangasianodon hypophthalmus*: 15%
- *Barbodes gonionotus*: 20-25%
- *Trichogaster pectoralis*: 20-25%
- *Barbodes altus*: 15-25%
- *Leptobarbus hoeveni*: 15-20%

Among the 5 indigenous fish species, *P. hypophthalmus* and *B. gonionotus* are very popular among fish farmers and they have usually been stocked together with exotic fish species in fishponds.

In order to compare the growth and production of indigenous fish species when they are stocked with exotic species, the survey included 14 fishponds that were stocked with a mixture of indigenous and exotic fish species. The species and stocking ratio were as follows:

- *Pangasianodon hypophthalmus*: 10-15%
- *Barbodes gonionotus*: 20-25%
- *Tilapia:* 30%
- *Silver carp*: 20%
- *Common carp*: 15-20%

With current on-farm resources available, small-scale fish farmers can not intensify their production with high level of stocking and high input. Therefore, it was recommended to stock an average of 3 fingerling/m^2.

The fish farmers attempted to stock big fingerling in order to keep high survival rate and obtain high fish production. The size of fish stocked was different from species to species. The average size of *P. hypophthalmus* seed was 7.5 cm, the average size of *L. hoeveni* was 5.5 cm and the other three species of *B. gonionotus*, *B. altus* and *T. pectoralis* were 4.5 cm in average. The average size of exotic fish seed was similar (5 cm).

9. Feeding

Type 1 farmers used similar types of feed and feeding to Type 2 farmers. Rice bran, broken rice, duckweed, termites, vegetable waste and rice wine waste were the typical foods used. The fish farmers used very high amounts of rice bran to feed fish, especially for *P. hypophthalmus*. The average amount of rice bran used was 194 kg/100m^2/8months.

The fish farmers sometime cooked rice bran with broken rice, so that the amount of broken rice used was 54 kg/100m^2/8months.

The natural feed, duckweed, was also used in large amounts. This feed could be collected in the village especially during the rainy season. The average wet weight of duckweed used was 193 kg/100m^2/8months.

Figure 1 shows the amount of feed used within culture period of 8 month in 100 m^2.

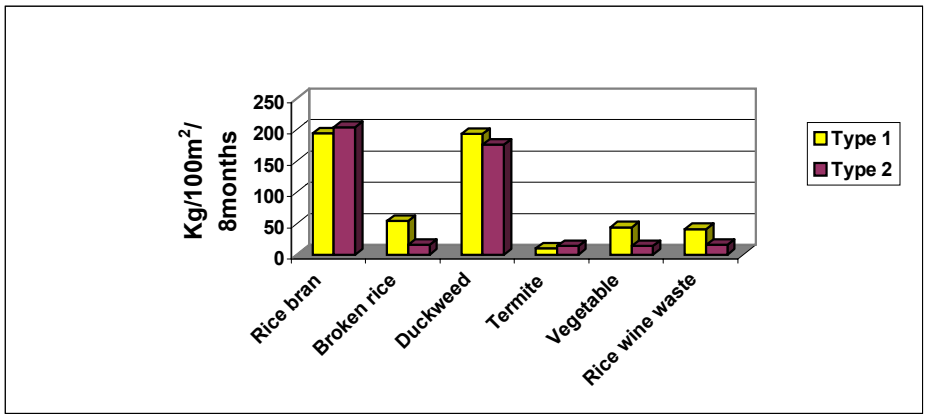

Figure 1: Amount of feed used within culture of 8 months in 100m^2

10. Yield

Within the 7-month culture period, the average actual indigenous fish yield (type 1) obtained by a family was 66 kg and this weight includes cultured fish (57 kg) and wild fish that entered fishpond (9 kg). For type 2, this yield was 59 kg (57 kg of cultured fish and 2 kg of wild fish). If the fish production was converted to fish yield per 100 m^2 per 8 months the overall fish yield of type 1 was 35 kg/100m^2/8months on average and overall fish yield of type 2 was 42 kg/100m^2/8months on average, the difference not being significant.

Among the 5 indigenous fish species, *P. hypophthalmus* gave the highest yields and contributed up to 40% of the total indigenous fish yield, followed by *B. gonionotus*, which contributed 27%. *B. altus* gave the lowest yield and contributed only 2%.

In type 2, when *P. hypophthalmus* and *B. gonionotus* were stocked with exotic species these two indigenous species contributed 18% and 12% only. Tilapia contributed up to 30% and Silver carp 21% of the total fish yield. The fish yield by species is illustrated in figure 2 and 3 as below.

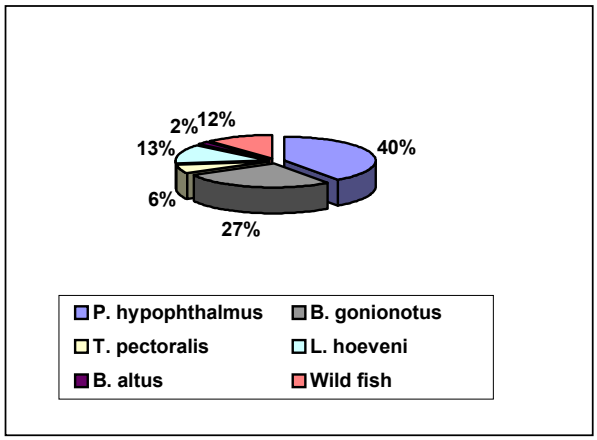

Figure 2. Fish yield by species in type 1.

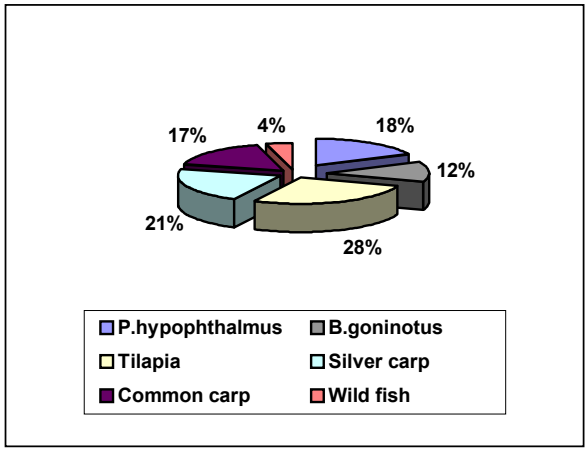

Figure 3. Fish yield by species in type 2

11. Survival rate

Among the 5 indigenous fish, the survival rate of the *P. hypophthalmus* was the highest at 85% on average, followed by *B. gonionotus* (77%) and *L. hoeveni* (41%). The survival rate of *B. altus* was only 35%. When *P. hypophthalmus* and *B. gonionotus* were stocked with exotic species the survival rate of these two species was still very high, even higher than the exotic species (Figure 4).

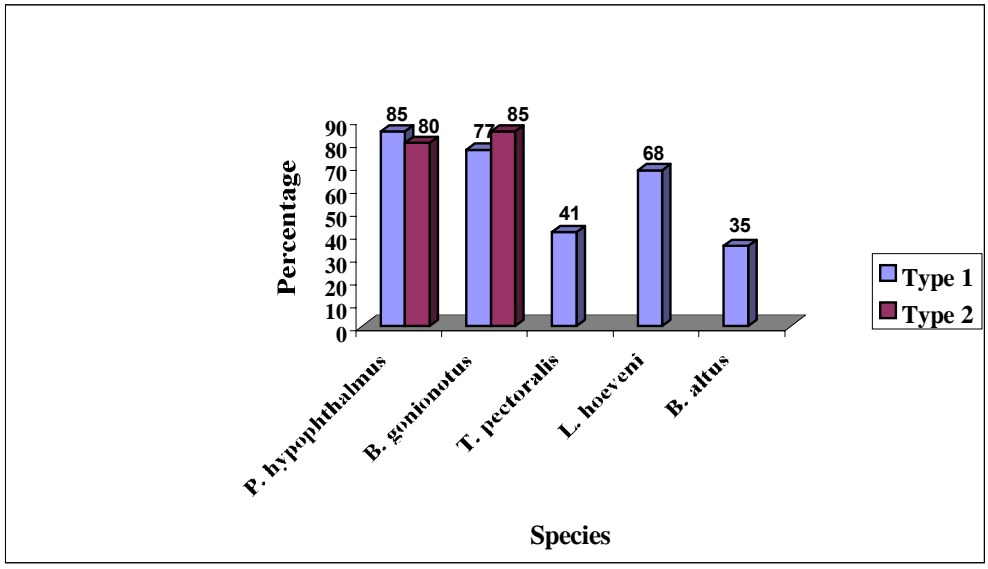

Figure 4: Average survival rate of indigenous fish in farmer ponds

12. Growth

The average growth of *P. hypophthalmus* was the highest at 1.4 gram per day. The second species was the *B. gonionotus* with an average growth of 0.58 gram per day, followed then by *L. hoeveni*, 0.44 gram per day. The species with slowest growth was *B. altus* (0.14g/day).

The average growth of *P. hypophthalmus* and *B. gonionotus* stocked with exotic species were significantly lower than when stocked with indigenous species. The average growth of these two species was then only 1.15 and 0.48 gram per day, respectively.

13. Financial evaluation

The cost of indigenous fish culture per 100 m^2 over 8 months includes costs of pond preparation, plastic bags, fish seed, fertilizer, feed and harvesting. The average total expenses for Type 1 farmers were 85500 riels/100m^2/8months and for Type 2 farmers 98800 riels/100m^2/8months. Compared with figures from READ (2000) on fish culture with exotic species, these above figures are higher. As the figures below show, the cost of feed was the biggest expense item in both culture systems, accounting for 45% of the costs in type 1 56% in type 2. Seed costs contributed 27 and 24% respectively. This cost was also high because the cost of indigenous fish species was higher than the cost of exotic species, especially *P. hypopthalmus* seed. Figure 5 and 6 illustrate the items of expense in percentage and riels per 100m^2 per 8 months.

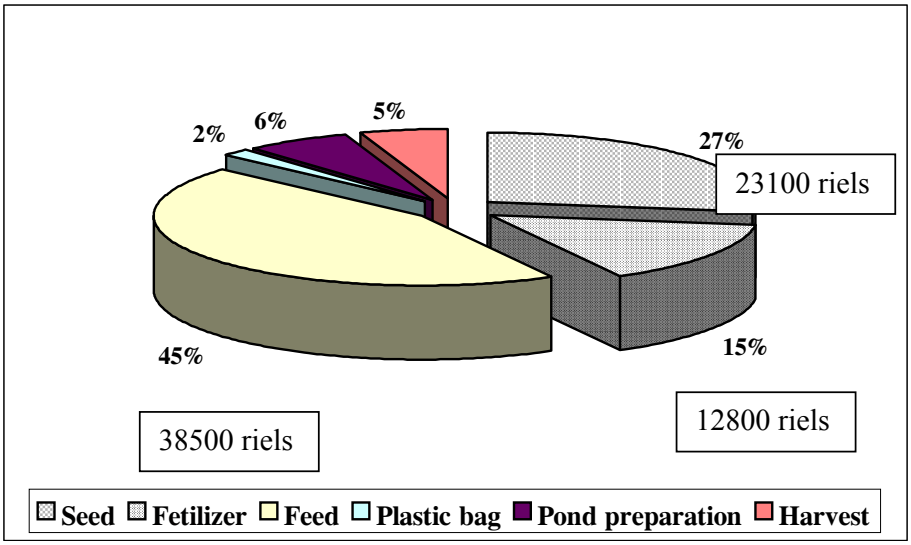

Figure 5: Expenditure percentage in Type 1

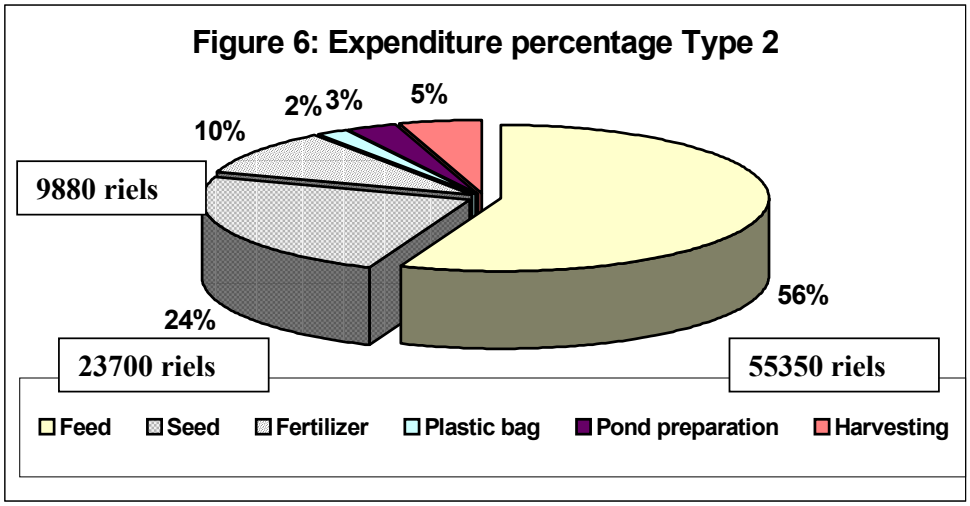

Figure 6. Relative Expenditure, Type 2

According to the survey the price of indigenous fish (3500 riels/kg in average) was a bit higher than the exotic species (3300 riels/kg). From the data analysis, the farmers who cultured indigenous fish species (type 1) obtained an average profit of 37500 riels/100m^2/8months and the farmers who cultured indigenous and exotic species (type 2) obtained average profits of 42000 riels/100m^2/8months. Although, the average total production of type 1 is lower than type 2, the profits are not significantly different. The profitability rate of type 1 was 51% and 58% for type 2. Compared to the data from

READ (2000) and PADEK (1996), both profitability rates of type 1 and type 2 are reasonable.

14. Contribution by family members in fish culture

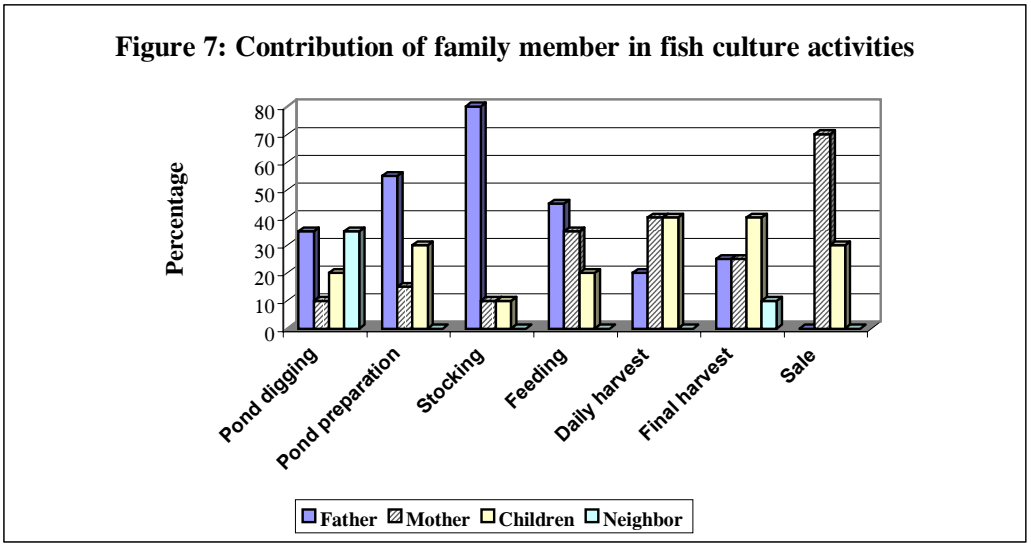

Figure 7. Contribution by family members in fish culture activities

Similar to culture of exotic species, for indigenous fish culture most fish culture activities are shared between husband, wife and children. If the husband is busy or goes away from home, the wife and children have to do all activities in the house. According to the survey, women are mainly involved with feeding, daily harvest and sale of the fish. Figure 7 shows the percentage contribution of family member in fish culture activities.

15. Constraints faced by farmers in fish culture with indigenous species

Due to very long drought and flooding, late seed stocking was the main problem, which all fish farmers faced. Slow growth and low survival rate of *B. altus* and *T. pectoralis* were also mentioned as a problem by fish farmers. The farmers did not recommend the use of these species, or recommended reducing their stocking rate. The constraints of fish culture with indigenous fish faced by fish farmers are ranged below:

- Late stocking
- Slow growth and high mortality of *B. altus* and *T. pectoralis* species
- Short culture period
- Small size of fish seed at stocking
- High mortality culture period
- High mortality when stocking

16. Towards aquaculture with indigenous species

Most farmers were happy with the result and the new species introduced in fish culture. *P. hypophthalmus, B. gonionotus* and *L. hoeveni* were the most popular species and after consultation with the farmers, we propose to continue working with these species in 2002-2003. The stocking ratio proposed by fish farmers are: *P. hypophthalmus* 40%, *B. gonionotus* 30%, *L. hoeveni* 20% and *T. pectoralis* 10%. Only two farmers from the 28 Type 1 farmers and one farmer from the 14 Type 2 farmers decided to stop.

17. Discussion

This trial has introduced a new technology and new indigenous species to rural farmers. The trial helps us to evaluate whether these techniques and species can be applied in rural areas.

The yield from culture of indigenous fish in fishponds is not significantly different from culturing a mixture of indigenous and exotic species.

Some indigenous fish grow very slowly (*B. altus* and *T. pectoralis*). When stocked with exotic species, *P. hypophthalmus* and *B. gonionotus* grow slower than the exotic species and slower than when they are stocked with other indigenous fish species. This may be because the indigenous fish species could not compete with the exotic species during feeding. However, *P. hypopthalmus* and *B. gonionotus* grow very fast, followed by *L. hoeveni* and the survival rate is also very high, when they are stocked with other indigenous species. The market demand and market price of indigenous species is higher than for exotic species and they can be sold everywhere.

From the above discussion we conclude that small-scale fish culture with indigenous fish species is feasible for rural farmers. *P. hypopthalmus, B. gonionotus* and *L. hoeveni* are the priority species that can be used to replace exotic species in small-scale fish culture.

More studies are needed on the general biology of these indigenous species and on optimal stocking and feeding ratios. These studies should be expanded to other remote areas, possibly through the cooperation with other organisations or projects.

18. References

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