Portable Canvas Tanks for Culture of Hybrid Catfish (*Clarias gariepinus* x *Clarias macrocephalus*) by Small-Scale Farmers in Malaysia

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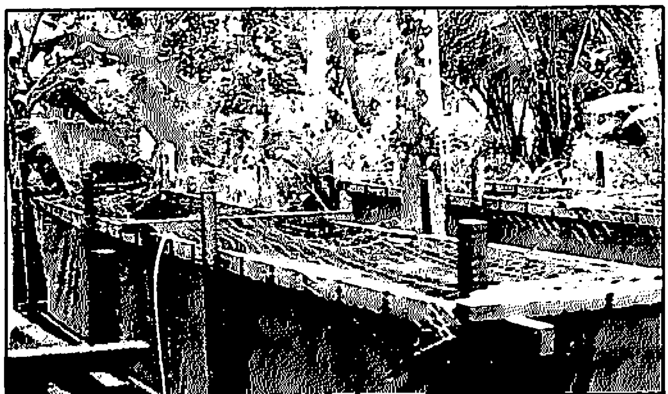
Introduction

In Malaysia, cultured fish is an important protein source, especially in inland areas where marine fish are not easily available and affordable (Ong 1983). Freshwater pond fish production is still relatively low: 8,268 t in 1990 (Anon. 1990). Small-scale farmers are reluctant to convert their land to ponds. The large capital required for pond construction discourages them. This paper describes trials with a simple portable canvas-tarpaulin tank system developed at the Universiti Sains Malaysia (Ali 1992).

The tank (6 m x 1 m x 1 m) and the supporting frames were constructed from waterproofed canvas-tarpaulin cloth and wood (4" x 2" building material). The cloth is widely used as a roofing material. It was cut to the size required, stitched and the joints waterproofed with canvas glue. A row of 1.5-cm diameter rope-holes were punched along the margin to tie-up the canvas to the wooden frames, held together by screws. Crossbars were used to strengthen the structure.

The feasibility of this culture system was tested with farmer cooperators. Four farmers (I-IV) from Balik Pulau District, Penang, each looked after one canvas tank stocked with 600 hybrid catfish fry (*Clarias gariepinus* x *Clarias macrocephalus*) (0.18 ± 0.03 g body weight). The fish were grown from 26 March to 2 July 1991, feeding (twice daily) cheap locally available materials such as chicken intestines, trash fish and kitchen refuse. Water replacement was 30-50% once a week for the first month



A typical portable canvas set up for clariid catfish culture.

and twice a week thereafter. Another farmer (V) from Yan District, Kedah, stocked each of three canvas tanks with 600 fingerlings (body weight range: 9.9-10.1 g) and reared them from 20 April to 31 August 1993. He took water at 5 l/minute, for about three hours daily, from a nearby mini-reservoir. The overflow was directed to an adjacent ricefield. He fed his fish on chicken intestines, obtained free from the local wet market and then cooked, at 5% body weight twice a day.

Visits were made twice monthly to all farmers to discuss management problems and to monitor fish growth and feeding schedules. During these visits, water quality parameters were tested using a Hach DR/EL 5 kit between 1100 and 1300 hours. At the end of the study, all the fish were harvested, weighed and measured (total length).

Results

The water quality parameters (means and standard deviations) for farmers I-IV who stocked fry, were: dissolved oxygen (DO), 2.60 ± 0.40 mg/l; temperature, 27.7 + 2.1°C; pH, 5.55 ± 0.08; and NH_3-N, 2.63 ± 0.05 mg/l. The corresponding ranges for farmer V who stocked fingerlings were: DO, 3.3-3.4 mg/l; pH, 6.4-6.5; and temperature, 26.7-26.8°C. Harvest data are shown in Table 1.

Table 1. Harvest data for tank-reared hybrid catfish (*Clarias gariepinus* x *Clarias macrocephalus*).

	Farmer no.				
	I	II	III	IV	V
Mean weight (g)	116.2	74.0	61.0	68.6	178.3
S.D.	49.5	41.0	26.8	39.5	32.1
C.V. (%)	43	55	44	58	18
Minimum weight (g)	14.0	10.0	8.0	10.0	100.0
Maximum weight (g)	280.0	250.0	228.0	260.0	350.0
No. survived	575	513	485	500	1,724
Survival (%)	96	86	81	83	96
Harvest (kg)	66.8	38.0	29.6	34.3	307.4

C.V. = coefficient of variation; S.D. = standard deviation; Farmers I-IV stocked fry; farmer V stocked fingerlings. Data for farmers I-IV are means of one tank per farm; data for farmer V are means of three tanks.

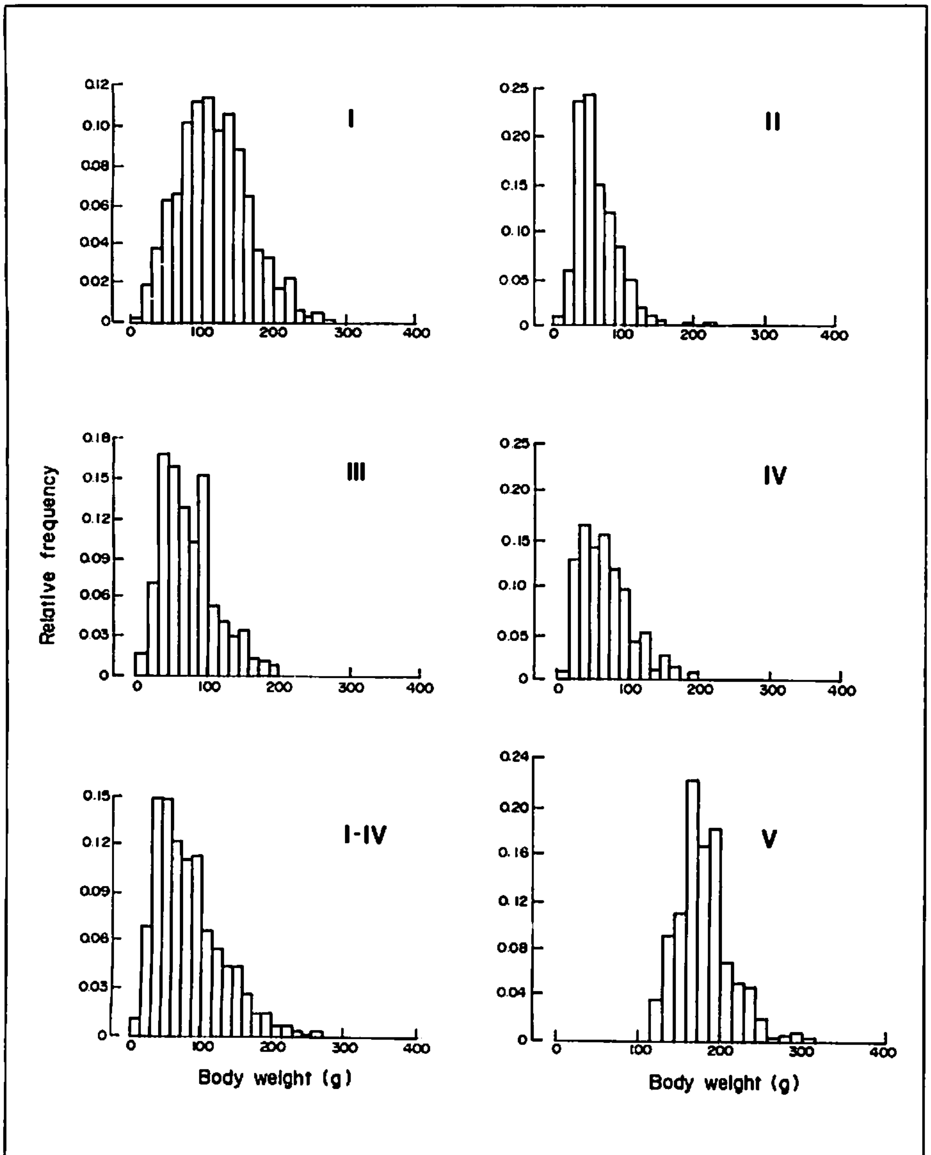


Fig. 1. ***Growth of hybrid catfish (*Clarias gariepinus *x* Clarias macrocephalus*) grown in canvas-tarpaulin tanks by farmer cooperators I-V, see text.***

The main constraint for farmers I-IV was a wide range in harvest sizes which prevented them from selling all their fish at once (Fig. 1). This unintentionally extended the growing period and therefore delayed the next culture cycle. For farmer V, the range of sizes at harvest of the larger fish obtained were narrower. Furthermore, farmers had to sell their fish at a relatively high price (US$3/kg) to obtain reasonable profits. For farmers I-IV, the average total cost per tank for this first culture cycle was US$122, whereas the gross income was only US$131. Enterprise budgets are shown in Tables 2 and 3.

For farmer V, the total amount of chicken intestines used for all the tanks was 968 kg and the feed conversion ratio (FCR) obtained was 3:1. Harvested fish were sold to an agent at US$1.36/kg. The total cost for the three tanks for this first culture cycle was US$327 and the gross income was US$416.

Discussion

The canvas tanks designed for this study are fully portable and can be dismantled and reassembled in about 30 minutes. Farmers could therefore stop their culture operations at any time and convert their land to other uses if the need arose. The canvas cloth is very durable and is the preferred material for these tanks. Materials such as plastics, even heavy duty ones, are not suitable due to their brittleness after exposure to sunlight. For the frames, materials such as bamboo or discarded lumber can be used. A tank can hold water up to half its total volume provided the frames and the seams are strong enough to support water pressure. Tanks constructed in 1987 are still in good condition and are in use.

Growth performance and harvests varied with the farmers' efforts and resources. For example, farmer I obtained better returns than farmers II-IV due to easy accessibility of trash fish from nearby commercial landings and due to good management: regular water exchange and tank cleaning.

Farmer V's use of fingerlings and cooked chicken intestines as feed, continuous water flow, and a culture period extended to 4.5 months, were based on earlier feedback from farmers I-IV. We had suggested using a commercial feed, but farmer V preferred to use the chicken intestines, because they were free and readily available. The intestines contained 35% protein, 13% lipid, 2% ash, 0.3% crude fiber, 8% moisture and 12% nitrogen free extract (NFE). The relatively high FCR (3:1) was probably due to their high moisture content. However, this ratio is still considered good compared to other wet feed materials (Pathmasothy and Lim 1987).

Water quality management can influence farmed fish growth. Since no aeration was provided, the DO levels in the tanks were low, especially towards the end of the growing period. The fish compensated by breathing atmospheric air. Water depth was maintained at about 0.3-0.6 m to reduce their surfacing distance and water exchange cost. Mortalities occurred primarily during the first and second weeks of culture and were probably due to transportation and stocking stress. There was also some evidence that missed feedings can result in cannibalism. High ammonia levels were compensated in part by the low pH. Moreover, this species of catfish is highly tolerant to toxic or growth-limiting water quality parameters such as ammonia, nitrite and carbon dioxide.

The Future

In Malaysia, catfish can be marketed between 100 and 110 g. The use of chicken

Table 2. An enterprise budget for culturing hybrid catfish (*Clarias gariepinus* x *Clarias macrocephalus*) in one canvas tank, stocking the fish as fry. The data are means from four farmer cooperators (I-IV), see text. Four production cycles (total time, 2 years) were used in the calculations.

	Initial investment	Cycle I	Cycle II	Cycle III	Cycle IV
A. Gross income/sales (US$)		130.68	130.68	130.68	130.68
B. Variable costs (US$)		61.50	61.50	61.50	61.50
Fingerlings plus transportation		32.85	32.85	32.85	32.85
Feeds plus transportation		26.09	26.09	26.09	26.09
Interest on variable capital (8.4%)		2.56	2.56	2.56	2.56
C. Operating income [A-B] (US$)		69.18	69.18	69.18	69.18
D. Capital costs (US$)	104.15				
Canvas tanks	91.24				
Bamboo frames	3.64				
Ropes	3.65				
PVC piping/fittings	5.62				
E. Fixed and opportunity costs (US$)		60.75	53.52	51.76	49.98
Depreciation		9.89	9.89	9.89	9.89
Canvas tanks		7.60	7.60	7.60	7.60
Bamboo frames		0.91	0.91	0.91	0.91
Ropes		0.91	0.91	0.91	0.91
PVC piping/fittings		0.47	0.47	0.47	0.47
Principal payment on fixed capital		26.04	26.04	26.04	26.04
Interest on fixed capital (13.5%)		7.03	5.27	3.51	1.73
Opportunity labor costs (operator)		17.79	12.32	12.32	12.32
F. Total costs [B+E] (US$)		122.25	115.02	113.26	111.48
G. Net returns to management and land [A-F] (US$)		8.43	15.66	17.42	19.20
H. Percentage returns [G/A]		6.4	12.0	13.3	14.7

Table 3. An enterprise budget for culturing hybrid catfish (*Clarias gariepinus* x *Clarias macrocephalus*) in three canvas tanks, stocking the fish as fingerlings and feeding them with cooked chicken intestines obtained free of charge. Four production cycles (total time, 2 years) were used in the calculations.

	Initial investment	Cycle I	Cycle II	Cycle III	Cycle IV
A. Gross income/sales (US$)		415.51	415.51	415.51	415.51
B. Variable costs (US$)		172.00	172.00	172.00	172.00
Fingerlings plus transportation		145.52	145.52	145.52	145.52
Feeds plus transportation		19.55	19.55	19.55	19.55
Interest on variable capital (8.4%)		6.93	6.93	6.93	6.93
C. Operating income [A-B] (US$)		243.51	243.51	243.51	243.51
D. Capital costs (US$)	331.92				
Canvas tanks	291.83				
Bamboo frames	10.92				
Ropes	11.67				
PVC piping/fittings	17.50				
E. Fixed and opportunity costs (US$)		154.60	143.53	137.93	132.33
Depreciation		31.43	31.43	31.43	31.43
Canvas tanks		24.32	24.32	24.32	24.32
Bamboo frames		2.73	2.73	2.73	2.73
Ropes		2.92	2.92	2.92	2.92
PVC piping/fittings		1.46	1.46	1.46	1.46
Principal payment on fixed capital		82.98	82.98	82.98	82.98
Interest on fixed capital (13.5%)		22.40	16.80	11.20	5.60
Opportunity labor costs (operator)		17.79	12.32	12.32	12.32
F. Total Costs [B+E] (US$)		326.60	315.53	309.93	304.33
G. Net returns to management and land [A-F] (US$)		88.91	99.98	105.58	111.18
H. Percentage returns [G/A]		21.4	24.1	25.41	26.76

intestines is preferred by small-scale farmers because they are free or relatively inexpensive. However in the long run we foresee greater use of commercial feed pellets due to their better FCR, reliable supply and lesser water quality problems.

The enterprise budgets indicated better returns if more tanks are used. From our experience, one small-scale farmer can manage up to 10 tanks effectively, even on a part-time basis and the adoption period for the technology is only between 7 to 10 days. With better quality food and water quality management, we are confident that farmers can obtain better harvests. The high tolerance to water quality extremes of clariid catfish, their ability to breathe air and their omnivorous habits recommend them for this kind of tank culture. Species with more stringent water quality requirements such as tilapia (*Oreochromis* spp.) would not be suitable unless continuous aeration and/or water flow is provided.

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Present Status of Mangrove Crab (*Scylla serrata* (Forskal)) Culture in China

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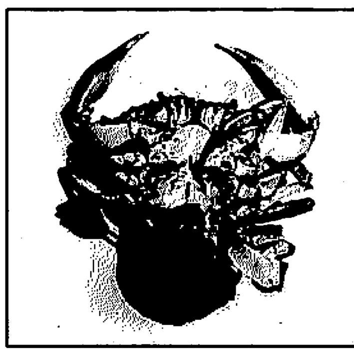
The mangrove crab *Scylla serrata*, locally called "Xun", is valued in China for its delicate flavor and good nutrition. Few crabs are caught by fishers and the demand is great so the price is expensive. Crab culture in Dong Wan, Guangdong Province, China, dates from 1890. Farmers there have accumulated rich experience on crab rearing in ponds through one hundred years of practice. Mangrove crab culture from southern Guangxi Province to northern Jiangsu Province has also been forging ahead in the past decade. The area under mangrove crab culture in 1988 was more than 20,000 mu (1 mu = 0.067 ha), producing in total more than 2,000 t.

Basic research has been carried out by Huang Shengnan and Li Wanli (1965), who described larval development; Wang Guizhong and Li Shaojing (1989), who reported that diethylstilbestrol influences the survival, feeding intensity and molting of juvenile crab; and Zheng Chaoshu et al. (1991), who studied the effects of temperature on embryonic development, inducing mature females to spawn out of normal spawning season and hatching unattached eggs.

Artificial Propagation

Before 1980, all cultured crabs were grown from natural seed. Thereafter, research institutes in Guangxi, Guangdong, Fujian, and Jiangsu Provinces have reported successful rearing (e.g., Wu Qinse and Zeng Weibing 1990). The problems of inducing spawning, hatching and rearing larvae have been solved step by step, although the quantities supplied by artificial reproduction are not yet enough to meet farming needs. The East China Sea Fisheries Research Institute, Shanghai, has also carried out research work on mangrove crab culture. Records of hatching 600,000 zoea larvae from one crab and getting 3,700 seed per cubic meter have been reported by Zhangjiang Fisheries University.



Female mangrove crab bearing eggs.

The key to artificial propagation is getting sufficient berried crabs. Crabs whose ovaries are well developed are selected, fed with good quality food and provided with a good environment. Water temperature is usually kept at 25-30°C during hatching. The eggs hatch after an 11-18-day incubation period. Hatching rates vary with culture conditions and can reach 90%.

The new larvae can eat algal cells, Artemia, rotifers, fertilized mollusc eggs, yolk and minced bivalve meat, etc. The survival rate of zoea larvae is highly related to the type, size, quantity and suitability of early diets.

Mangrove Crab Culture

Traditionally, culture was actually a method of fattening. Farmers simply caught crabs of at least 200 g, put them into enclosed ponds, and fattened them for 15-50 days. It is important to select robust young crabs for pond culture.