

PRESENT STATUS OF PEN AND CAGE CULTURE OF FINFISHES IN SOUTHEAST ASIA

K. M. S. AMBER HANSA *

Tuticorin Research Centre of CMFRI, Tuticorin - 628 001.

ABSTRACT

Cage and pen culture practices in certain Southeast Asian countries viz. India, Bangladesh, Sri Lanka, Indonesia, Singapore, Malaysia, Thailand, Cambodia, Vietnam and Philippines have been reviewed in this paper. The various methods adopted and materials used in the design and construction of cages and pens and the different species of fishes cultured in these two systems are discussed. The possibilities for adopting pen and cage culture practices for fish production in India are also indicated.

INTRODUCTION

The pen farming had probably started in Asia in the early 1920's in Japan (Milne, 1979). In Southeast Asia, Philippines is the only known country where pen culture of fish has been extensively developed very recently (Mana, 1982).

Cage culture of fish originated in the Far East about a century ago. The practice was first described by Lafont and Saveun in 1951 (Hickling, 1962). In the early years it was used primarily for cultivating freshwater fishes. During the last decade, the technique has been adopted for both freshwater and marine fishes.

This paper reviews the present status of pen and cage culture of fin-

fish in Southeast Asia and the details are summarised in Table 1 and 2.

INDIA

Experimental pen culture of *Chanos chanos* and *Mugil* spp. has been made recently by the Central Marine Fisheries Research Institute at Mandapam (Venkataraman *et al*, 1979). Squarish pens of bamboo designed to withstand wave actions for a longer period were constructed. Each pen of 81 m² area consists of a double layered 'thatti' (screen made of bamboo splits), an outer layer made of splits of 9 mm thickness and an inner layer of 5 mm thick splits.

Experiments have been conducted by the Central Inland Fisheries Research Institute to study the feasibility of

* Present address: Mandapam Regional Centre of CMFRI, Mandapam Camp.

raising quality freshwater fish seeds in floating nurseries and raising fish of marketable size in cages in a tank with an area of about 1 ha. at Jari, Allahabad (Natarajan, 1979). The tank had a depth of 2.4 to 3.0m and cages were floated in the deepest area of the tank. Cages measuring $2.20 \times 1.60 \times 1.45$ m were used for rearing the hatchlings, fry and early fingerlings and for the advanced fingerlings, the size of the cage was standardised to $2.0 \times 1.5 \times 1.5$ m.

BANGLADESH

Floating and fixed cages measuring $7 \times 4 \times 4$ m have been constructed with bamboo poles and nylon net of mesh size 6mm for the enclosure at Dhanmondi lake, Dacca and Nile tilapia, *Tilapia nilotica* was cultured (Karim, 1982) The fixed cage was for the culture of Indian major carps, common carp and silver carp.

SRI LANKA

Culture of *T nilotica* in cages has been tried in Sri Lanka (Siriwardena, 1982). Net cage measuring 2 m^2 and 2.25 m^2 were used to study the growth of *T nilotica* at different stocking rates with two feeding regimes (5% and 10% of body weight).

INDONESIA

Cages made of hard wood with dimension of $4 \times 2 \times 2$ m are floated with the help of logs. The freshwater fishes viz. *C. striatus* and *Oxyeleotris marmoratus* are commercially cultured in cages. The stocking density per cage is 1000 fingerlings and the fish are fed with chopped trash fish at the rate of 5 - 10 kg / cage / day.

In the coastal waters of Indonesia, culture of *Epinephelus tauvina*, *Plectro-*

pomus leopardus and *Lates Calcarifer* was carried out in cages of $3 \times 4 \times 6$ m size (Lanjumin, 1982).

In West Java, net cages of $3 \times 3 \times 2$ m size are used in the culture of the common carp, *Cyprinus carpio* (Jangkaru, 1979).

SINGAPORE

Several species of marine fishes such as *E. tauvina*, *L. calcarifer* and *Lutjanus* sp. are cultured in cages in Singapore (Lee, 1982). Fish seeds are imported from nearby countries namely Thailand, Malaysia, Indonesia and Philippines. Net cages of $2 \times 2 \times 2$ m to $5 \times 5 \times 3$ m are made to float by means of plastic drums and metal drums attached to wooden framework. The mesh size of the net varies from 6 to 12 mm.

MALAYSIA

Culture of finfish such as *Epinephelus* spp., *L. calcarifer*, *Lutjanus russelli* and *Siganus javus* in cages has been attempted by Malaysia recently (Rahim, 1982).

The freshwater fishes such as carps, gobids, rohu, giant gourami and tilapia are also being cage cultured in some parts of Malaysia. Net cage of $5.0 \times 5.0 \times 2.5$ m size are used for the culture of bighead carp *Aristichthys nobilis*, (Khalil, 1982).

THAILAND

In Thailand freshwater fishes such as catfish *Pangasius sutchi*, *Clarius macrocephalus*, marble goby, *Oxyeleotris marmoratus*, *C. carpio*, *Puntius gonionotus*, *T. nilotica* and *C. striatus* are cultured in bamboo or wooden cages which are floated in the rivers or canals (Tugsin, 1982).

TABLE 1 :- Pen culture in India and Philippines.

Country	Fish Pens									
	Type	Size	Material	Mesh size	Fish cultured	Stocking density and size	Feeds	Growth	Production	Reference
India	Square	9 × 9m	Split bamboo poles	—	<i>Chanos chanos</i>	2,000 /ha (60-90mm)	Minced fish meat and oil cake (1:1)	51 mm / month	8t/ha	Venkataraman et al., (1979)
					<i>Mugil spp.</i>	42,000/ha (mean size -32 mm)		18 mm / month	6t/ha	
Philippines	Circular, rectangular, square or hexagonal	0.5-1000 ha	Polyethylene nets	10-25 mm	<i>C. chanos</i> , <i>Tilapia nilotica</i>	25,000 - 30,000/ha	Rice bran or poultry feed or popcorn or fish meal (10% of body weight)	Marketable size- 200-250g in 4-5 months	—	Castillon (1982) and Guerrero (1982)

TABLE 2:- Cage culture in various countries

Country	Fish cages									
	Type	size	Materials	Mesh size	Fish cultured	Stocking density & size	Feed	Growth	Production	Reference
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
India	Rectangular (Floating)	2.20x 1.60x 1.45m	Nylon net	1/8"	<i>Catla</i> <i>catla</i> , <i>Labeo</i> <i>rohita</i> & <i>L. bata</i>	10,000 spawn/sq. m. (mean size 6.5 and 7.8 mm)	Soya bean powder, ground nut oil cake and rice polish (1:1:1)	37.8 mm in 28 days and 23.7 mm in 28 and 21 days for hatchlings 76.2 mm in 89 days and 73.4 mm in 82 days for fry/ fingerlings.	—	Natarajan et. al (1979)
		2.0x 1.5x 1.5m	Galva- nised iron	1/5"	<i>Cirrihina</i> <i>mrigala</i>	2800 fry/ sq. m (mean size 30.2 and 45.6mm)				
Bangla- desh	Floating and fixed	7x 4x 4m	Nylon net	6mm	<i>T. nilotica</i> , <i>C. catla</i> , <i>C. mrigala</i> , <i>Cyprinus</i> <i>carpio</i> , <i>Hypophthal-</i> <i>michthys</i> <i>molitrix</i>	500/cage (50-75 mm)	Mustard oil cake and wheat bran - 1:1 (5% of body weight)	—	31.29 metric tons/ha in 6 months <i>T. nilotica</i>	Karim et al (1982)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Sri Lanka	Fixed	2m ³ and 2.5m ³	Nylon net	—	<i>T. nilotica</i>	600-1500 and 600-1000	Pelleted & Compound- ed feed (rice bran and leaves of <i>Ipil - ipil</i> and mannihot coconut, residue and fish offal)	—	—	Siriwar- dena (1982)
Indo- nesia	Floating	4x2x2 m	Hard- wood	—	<i>C. stria- tus</i> , <i>Oxveleo- tris</i> <i>marmora - tus</i>	1000 finger- lings/ cage	Trash fish (5-10 kg / cage / day)	—	600 kg/ cage in six months	Indra (1982)
	Floating	3x4x6 m	Nylon net	—	<i>Epinephe- lus</i> <i>tauvina</i> , <i>Plectropo- mus</i> <i>leopardus</i> and <i>Lates</i> <i>calcarifer</i>	800 juve- niles / cage (150/200g/ fish)	Trash fish from 150- 200 g to 600-700 g/ fish in 5-6 months	—	—	Lanjumin (1982)

Country	Fish cages									
	Type	Size	Materials	Mesh size	Fish cultured	Stocking density & size	Feed	Growth	Production	Reference
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Floating	3x3x2 m	Nylon net	—	<i>C. carpio</i>	2kg, 4kg and 6 kg/m ³ (130 g/fish)	Pelleted feed (crude protein-32%)	1.27%, 1.30% and 1.51% / fish/day	—	Jangkaru (1979)
Singapore	Floating	2x2x2 m to 5x5x3m	Nylon net	6 to 12 mm	<i>Epinephelus tauvina</i> , <i>L. calcari-fer</i> & <i>Lutjanus</i> spp,	400 - 600 (75 - 100 mm) in cage 2x2x2 and 1100 (125-150 mm) in cage 5x5x3	Trash fish (5-10% of body weight)	From 100 g to 600 - 800 g in 6-8 months (80-100 g/month)	—	Lee (1982)
Malaysia	Floating	5x5x2.5 m	Nylon-net	—	<i>Epinephelus</i> spp., <i>L. calcari-fer</i> , <i>Lutjanus russelli</i> and <i>Siganus iavus</i>	—	Trash fish	<i>Epinephelus</i> (0.6 kg in 10-12 months) <i>L. calcari-fer</i> (1.3 kg in 1 year)	—	Rahim (1982)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Floating	5x5x2.5 m	Polye thylene	25.4 mm	Carp, gobies, rohu, giant- gourami and Tilapia	6, 12 and 24 fish/m ³ (Bighead carp)	—	—	887 87 kg (6/m ³), 987.20 kg (12/m ³), and 1384.41 kg (24/m ³) /150m ² (Big- head- carp)	Khalil (1982)
Thai- land	Floating	10-15 m ²	Bamboo or Wooden	—	Catfish, gobids, carps and <i>T. nilotica</i>	100/m ³ (100-300g / fish)	Trash fish (10% of body weight)	600 g/ fish in 6-8 months (<i>Oxyeleo- tris marmora- tus</i>)	—	Tugsin (1982)
	Floating	2x2x2 m and 3x3x3 m	Nylon net	20-50 mm	<i>L. calcari- fer</i> , <i>Epinephe- lus tauvina</i> , <i>Epinephe- lus</i> spp., <i>Lutjanus</i> spp., and <i>Siganus</i> spp.	500 fry / m ² (10-15 mm) and 30 finger- lings/m ² <i>L. Calcari- fer</i>	Trash fish 10% of body weight)	—	—	Tanomkiat (1982)

Fish cages

Country	Type	Size	Materials	Mesh size	Fish cultured	Stocking density & size	Feed	Growth	Production	Reference
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Cam bodia	Floating	40 to 625 m	Bamboo and Wooden	—	<i>Pangasius</i> , <i>Clarius</i> and <i>Oxyeleo- tris</i>	6,000- 10,000 fry/cage	Small fish- cooked vegetables and rice bran; big- ger fish- raw fish and kitchen refuse (1:1)	1.5-2.5 kg/fish in 9 months	—	Guerrero III (1982)
Vietnam	Floating	60-181 m ³	Bamboo and wood	—	<i>Barbus</i> , <i>Leptobar- lus</i> , <i>Pangasius</i> and <i>Channa</i>	80-361 fry/m ³	Vegetables and animal products	—	3,000- 25,000 kg/cage/ year	Pantulu (1979)
Philip- pines	Floating	1 m ³ to 50 × 25 × 5 m	Nylon net	12.7- 25 mm	<i>T. nilotica</i>	16 finger- lings/m ³ 5-10g each)	Mainly natural food (occasion- ally rice bran used)	Marketable size 100-150g in 6 months	—	Guerrero III (1979)
	Floating	6x1.9-3 x1-3.5m	Poly- ethylene nets	—	<i>Siganus</i> spp.	400-500 fry/m (20-25 mm)	Marine algae and rice bran	Marketa- ble size- 85-100g/ fish.	—	Castillon (1982)

The marble goby is an important food fish of Thailand. Wooden cages of 10-15 m² size and 1.5 m deep are invariably used for its culture. Marine species such as *L. calcarifer*, *Epinephelus* spp., *Lutjanus sebae*, *L. johni*, *L. russelli* and *Siganus* sp. are also cultured in cages made of nylon netting with dimensions of 2 × 2 × 2 m and 3 × 3 × 3 m and mesh size of 2-5 cm (Tanomkiat, 1982).

CAMBODIA AND VIETNAM

In Cambodia, species of *Pangasius*, *Clarias* and *Oxyeleotris* are cultured in large sized floating cages made of bamboo poles and splints supported with wooden planks and beams. The size of the floating cages varies from 40 to 625 m² (Guerrero, 1982).

Cambodians have introduced cage culture in Vietnam. The main species cultured are *Barbus*, *Leptobarbus*, *Pangasius* and *Channa*. The size of cages varies from to 60 181 m (Pantulu, 1979).

PHILIPPINES

In the Philippines, there are about 2,50,000 ha. of lakes, rivers, reservoirs and swamps which could be profitably utilized for fish production through cages and pens (Guerrero, 1979). Laguna de Bay is the largest lake with an approximate area of 91,000 ha. Profound changes had taken place during the last decade when *Tilapia* was introduced into the Laguna de Bay and *Tilapia* culture became very widespread. At present *Tilapia* forms one of the most important and accepted food fishes in the Philippines. *T. nilotica* is the main

species commercially cultured in cage and pens all over Philippines.

Cages of different sizes varying from 1 × 1 × 1 m to 50 × 25 × 5 m are used for rearing the fry and fingerlings of *T. nilotica* in various parts of Philippines. The mesh size of the net varies from 12.7 to 25.0 mm (Guerrero, 1979).

Experimental culture of *Siganus* spp. in floating net cages is being carried out in Philippines at present and the results are encouraging. The cages measure 6 m long, 1.9 - 3.0 m wide and 1.0 - 3.5 m high (Castillon, 1982).

Chanos chanos is cultured in circular, rectangular or square pens constructed with polyethylene nets bamboo poles and nylon ropes (Castillon, 1982 and Guerrero, 1982).

ACKNOWLEDGEMENTS

I am very grateful to Dr. E. G. Silas, Director, Central Marine Fisheries Research Institute (ICAR) and UNDP/FAO for sponsoring me for the training on "Cage and pen culture" at Southeast Asian Fisheries Development Centre Aquaculture Department, Binangonan, Philippines during October - December, 1982. I also express my sincere thanks to Dr. B. Krishnamoorthy, Head of Demersal Fishery Resources Division and to Dr. K. Satyanarayana Rao, Scientist S-2, Central Marine Fisheries Research Institute for critically going through the manuscript and offering valuable suggestions.

REFERENCES

- Alferez, V, 1982. Fishpen design and construction. Report of the Training Course on Small-Scale Pen and cage Culture for finfish. South China Sea Fisheries Development and Coordinating Programme, Manila, Philippines, p. 23-51.
- Castillon, W. Z., 1982. Pen and cage Culture of finfish in the Philippines Report of the Training Course on Small-Scale Pen and Cage Culture for finfish. South China Sea Fisheries Development and Coordinating Programme, Manila, Philippines, p. 187-190.
- Guerrero, R D. 1979. Cage culture of *Tilapia* in the Philippines. International Training Workshop on pen and cage culture of fish, February 11-22, 1979. Tigbauan, Iloilo, Philippines, p. 105-106.
- Guerrero, 1982. Status of pen and cage culture in various countries. Second International Training on Cage and Pen culture of *Tilapia*. October 4-December 2, 1982, Binangonam, Philippines, p. 1-12.
- Hickling, C. F., 1962. Fish culture. Faber and Faber, Lodon, 295 pp.
- Indra, R., 1982. Fish cage culture development in East Kalimantan Province, Indonesia. Report of the Training Course on Small Scale pen and Cage Culture for finfish. South China Sea Fisheries Development and Coordinating Programme, Manila, Philippines, p. 163-164.
- Jangkaru, Z. and Rustami Djajadiredja, 1979. Common carp in floating net cage culture. International Workshop on Pen and Cage culture of fish. February 11-22, 1979. Tigbauan, Iloilo, Philippines, p. 55-60.
- Rarim, M. R. and A. K. M. Harun-al-Rashid Khan, 1982 Small scale pen and cage culture for finfish in Bangladesh. Report of the Training Course on Small-Scale Pen and Cage culture for Finfish. South China Sea Fisheries Development and Coordinating Programme. Manila. Philippines, p. 157-160.
- Khalil, R. 1982. Cage culture in freshwater in Malaysia with emphasis on the program of the Freshwater Fish Culture Research Station (MARDI), Batu Berendam, Malacca, Malaysia. Report of the Training Course on Small-Scale Pen and Cage Culture for Finfish. South China Sea Fisheries Development and Coordinating Programme, Manila, Philippines, p. 177-185.
- Lanjumin, L. 1982. Development of cage culture of finfish in Riau Archipelago, Riau Province, Indonesia. Report of the Training Course on Small-Scale Pen and Cage Culture for Finfish. South China Sea Fisheries Development and Coordinating Programme, Manila, Philippines, p. 165-166.
- Lee, E. S. 1982. Cage culture for marine finfish in Singapore. Report of the Training Course on Small-Scale Pen and Cage Culture for Finfish. South China Sea Fisheries Development and Coordinating Programme. Manila, Philippines, p. 197-199.

- Mane, A. M., 1982. Management and maintenance of fishpens in Laguna de Bay. Report of the Training Course on Small - Scale Pen and Cage Culture for Finfish. South China Sea Fisheries Development and Coordinating Programme, Manila, Philippines, p. 57-63
- Milne, P. H., 1979 Selection of sites and design of cages, fishpens and net enclosures for aquaculture. In : Advance in Aquaculture. (ed T. V. R. Pillay and Wm. A. Dill) Fishing News Books Ltd., England, p. 416-423.
- Natarajan, A. V., R. K. Saxena and N. K. Srivastava, 1979. Experiments on raising quality fish seed in floating nurseries and its role in aquaculture in India. International Workshop on Pen Cage culture of fish. February, 11 - 22. 1979. Tigbauan, Iloilo, Philippines, p. 45 - 49.
- Pantulu, V. R., 1979. Floating cage culture of fish in the lower mekong River Basin. In : Advance in Aquaculture. (ed. T. V. R. Pillay and Wm. A. Dill) Fishing News Books Ltd., England, p. 423 - 427.
- Rahim, B., 1982. Cage of finfish in Peninsular Malaysia, Report of the Traing Course on Small-Scale Pen and Cage Culture for finfish. South China Sea Fisheries Development and Coodinating Programme, Manila, Philippines. p. 173 - 176.
- Siriwardena, P. P. G. S. N., 1982 Future plans for pen culture and small-scale cage culture in Sri Lanka. Report of the Training Course on Small - Scale Pen and Cage for Finfish. South China Sea Fisheries Development and Co-ordinating Programme, Manila, Philippines, p. 201 - 204.
- Tanomkiat, T., 1982. Programme on cage culture at the Phang Nga Small-Scale Fisheries-Assisted Project, Phang Nga Province, Thailand. Report of the Training Course on Small-Scale Pen and Cage Culture for Finfish, South China Sea Fisheries Development and Co-ordinating Programme, Manila, Philippines. p. 213.
- Tugsin, Y , 1982. Cage culture of freshwater finfish in Thailand. Report of the Training Course on Small - Scale Pen and Cage Culture for Finfish, South China Sea Fisheries Development and Coordinating Programme, Manila, Philippines, p 205 - 206
- Venkataraman, G., K. M. S. Ameer Hamsa and P. Nammalwar, 1979. Pen Culture. International workshop on Pen and Cage Culture of fish, February 11-22, 1979, Tigbauan, Iloilo, Philippines, p. 41-44.
-