



# Fry and fingerling transportation in the striped catfish, *Pangasianodon hypophthalmus*, farming sector, Mekong Delta, Vietnam: A pivotal link in the production chain



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## ABSTRACT

The striped catfish, *Pangasianodon hypophthalmus*, farming sector in the Mekong Delta, Vietnam (8°33′–10°55′ N; 104°30′–106°50′ E), has been one of the major global aquaculture successes. The sector currently produces over a million tons, of export value of 1.4 billion US\$, in an area of about 7000 ha and provides employment to over 180,000. Catfish farming is pond based, along two main branches of the Lower Mekong and associated waterways. The sector has integrated independent sub-sectors viz. hatchery production, fry to fingerling rearing and grow-out and product processing for export. These are linked through coordinated transportation by water using especially designed boats with the ability to navigate narrow channels along the production chain. This paper deals with the aspects of transportation of 2,264,448 fry/fingerlings, weighing approximately 48,330 kg, to grow-out operations involving 20 producers. All transportation is by boat, of two size classes, 20 and 30 t capacities, with easy access to farms. In general, a fry/fingerling farmer enters into a contract for the transportation to a grow-out farmer and a number of trips are required to complete an operation, depending on the size of the fish and the densities at transportation. Transportation mortalities were relatively low but on delivery to the grow-out farms mortalities increased in the first two days post-stocking and decreased gradually. A cost analysis of the transportation sector is provided and it was seen that the return of the capital cost per year on a boat was relatively high.

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## 1. Introduction

The striped catfish, also commonly known as tra and sutchi catfish (*Pangasianodon hypophthalmus*) farming in the Mekong Delta, Vietnam (8°33′–10°55′ N; 104°30′–106°50′ E), is considered as a major aquaculture success story of Asia, if not globally (Phuong and Oanh, 2010). Currently, its annual production exceeds 1 million t yr<sup>-1</sup>, generating 1.4 billion US\$ (2010) export income to Vietnam, employs over 180,000 persons and accounts for the highest average production ranging from 200 to 400 t ha<sup>-1</sup> crop<sup>-1</sup>, ever recorded for the primary production sector (De Silva and Phuong, 2011). In the recent past striped catfish farming has also developed in other countries in the region, such as for example Bangladesh (Ali et al., 2012).

The rapid development of the striped catfish farming sector in the Mekong Delta, over the last decade, attracted much global attention and has not been without controversy either, particularly in respect of sustainability and market related issues (see for e.g. Bush and Duijf, 2011; De Silva and Phuong, 2011; Little et al., 2012; Nguyen, 2010). Its importance has triggered many studies on a range of aspects pertaining to the sector in the recent years. Among some of the aspects that have

been studied include genetics (Ha et al., 2009; Nguyen, 2009; Sang et al., 2012), nutrition, diet development and feeds (Asdari et al., 2011; Da et al., 2012; Glencross et al., 2011; Hien et al., 2010), hatchery production and operations (Bui et al., 2010; Cacot et al., 2002; Le and Le, 2010; Legendre et al., 2000), farming system (Da et al., 2012; Phan et al., 2009) and environmental impacts (Anh et al., 2010; Bosma et al., 2009; De Silva et al., 2010). In view of the societal importance of the striped catfish farming sector many social aspects on it also have been dealt with (Belton et al., 2011; Bush et al., 2009; Da et al., 2012).

Phan et al. (2009) and Bui et al. (2010) reported on the functioning of the striped catfish farming sector. These authors observed that it is essentially divisible into four sub-sectors consisting of hatchery production, fry to fingerling rearing, grow-out and processing sectors. Each of these sub-sectors functions independently, in space and time, but is highly integrated in the production chain.

The striped farming sector in the Mekong Delta is located on the banks of two major branches of the Lower Mekong River, Tien Giang (upper) and Hau Giang (lower), and the associated channels forming a myriad of waterways. The network of waterways is pivotal to the co-ordination of the production chain from one sub-sector to the other, with all product transportation between the sub-sectors by boat. The boats are specifically designed to transport live fry and/or fingerling and fish for processing (1 to 1.2 kg individual weight) to one of the

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many processing plants currently in operation. As such the transportation sector is a standalone sub-sector that is crucial to the production/market chain. However, there had not been any study on this sub-sector, the functioning and economics of which will have a significant impact on the overall viability of striped catfish farming in the Mekong Delta, a provider of food fish to many countries across the globe (Bush and Duijf, 2011; De Silva and Phuong, 2011; Little et al., 2012). Accordingly, this study deals with aspects on the transportation of fry to fingerling of striped catfish in the Mekong Delta, including a preliminary cost–benefit analysis of the sub-sector.

## 2. Materials and methods

The study was based in Can Tho, An Giang and Dong Thap provinces of the Mekong Delta, which is a predominant region for fry and fingerling production/supply to the striped catfish farming sector in the whole of the Mekong Delta (Bui et al., 2010). For the study 20 fry/fingerling farmers and boat operators involved in transportation of the produce to grow out farms were chosen, based on already established connections with the sector in relation to previous studies (Bui et al., 2010; Phan et al., 2009).

A structured questionnaire was used to obtain data from each of the selected fry/fingerling farmers and boat operators through face to face interview by experienced enumerators. The enumerators used in the current survey are those that conducted similar surveys on the farming on the catfish farming sector (Phan et al., 2009) and seed production (Bui et al., 2010). Accordingly, information on fry/fingerling farm size, the total number of stock to be transported and the average weight of the stock were obtained.

In the current study, for each boat, a team of observers accompanied on two fry/fingerling delivery runs to grow out farms. During each of the trips water quality parameters, temperature, pH, and dissolved oxygen, ammonia and nitrite concentrations (in ppm) in the hold containing the fish were measured at hourly intervals, at three points. The measurements were done using, Sera Test Kits (Hersteller Sera GmbH, D 5218 Heinsberg, Germany). Also, the number of mortalities was estimated by direct observation (dead, free floating fish) at hourly intervals.

On delivery of the fry/fingerlings to grow out operators daily mortalities were estimated up to the seventh day. Also, the temperature, pH, and dissolved oxygen, ammonia and nitrite concentrations at three points (surface) of the ponds into which fry/fingerling were introduced were also determined, at the time of transfer of the fish.

## 3. Results and discussion

Of the 20 chosen farmers 19 were fingerling farmers, each obtaining three crops per annum and the remaining fry rearing farmer obtained four crops per annum.

Generally, a fry/fingerling producer contracts a boat operator for the transportation of the entire stock to a designated grow out farmer. Furthermore, such contracts are often long term, a producer relying on a selected boat operator year after year. The stock are often reared in earthen ponds, ranging in size from 0.5 to 6 ha (mean = 2.51 ha; SE = 0.32), the great majority being less than 2 ha (also see Bui et al., 2010). Often fry/fingerling farmers are linked to specific grow out farmers on a contractual basis.

Fish ready for transportation is harvested over a day by herding into a corner of the pond using seine nets (1–1.5 cm stretched mesh) which are dragged along the bottom. The herded fish are not fed for a minimum of 24 h. On the day of transportation the fish are packed into oxygenated polythene bags and hand carried to the boat, former allowed to float in the hold for up to 0.5 h (for temperature adjustment) and the fish released into the holding facility in the hull. An average loading time for a consignment was approximately 1 h.

**Table 1**

Summary information of the boats operating in the transportation of fry/fingerlings in the striped catfish farming sector. Where relevant the mean and standard error are given (mean ± SE).

Parameter	Mean	Range	CV
Average life span (yr)	39.23 ± 1.23	30–45	0.14
Average cost of a boat <sup>a</sup>	248.46 ± 28.56	120–400	0.50
Capacity (t)	23.7 ± 1.14	20–30	0.26
Length (m)	15.025 ± 1.96	14–23	0.13
% operator owned	100 ± 0.00	0.00	0.00
Number of operations <sup>b</sup>	4.8 ± 0.22	2–6	0.20
Total average distance travelled/operation <sup>b</sup> (km)	71.23 ± 6.27	20–137	0.40
Time taken per average trip (h)	10.15 ± 5.33	3–18	0.52
No. of labour/trip per operation	2.85 ± 1.08	2–6	0.38
No. of trips/month	13.5 ± 0.23	10–15	0.07

<sup>a</sup> In million VND (20,000 VND = 1 US\$).

<sup>b</sup> Operation refers to the delivery of all stock from fry/fingerling farm to the receiving grow out farm.

### 3.1. Boats

The total number of boats catering to the whole of the striped catfish farming sector in the Mekong Delta (fry/fingerling transportation and table sized fish for processing) is estimated at 2800 (the information being obtained from the respective provincial fishery authorities). The boats, purpose built or modified fishing boats, are dedicated for providing transportation for the sector through the year. This is made possible because all stages of the production cycle occur through the year without any fallow periods (Phan et al., 2009). The boats are modified to retain water in the hull, but permitting exchange throughout the transportation through small (approximately 20 × 8 cm) metal netted apertures right around the hull. This constant exchange of water permits the fish to be maintained in good condition until delivery to the processing plants. Boats do not use any aeration mechanism.

The boats used in this sub-sector are of two basic groups, those of 20 and 30 t capacities this being perhaps dictated by the nature of waterways they have to navigate in, some being narrow and fairly shallow. The mean capital costs of the two groups of boats are 128.75 (±2.14) VND and 364.29 (±25.60) million VND or US\$ 6438 and 18,215 (conversion rate: 20,000 VND = 1 US\$), respectively, and were significantly different from each other ( $P < 0.01$ ). Some of the other relevant features of the boats are given in Table 1.

In general, a contract is entered into between a fry/fingerling farmer and a boat operator for the transportation of the whole stock to the recipient grow out farm. Accordingly, to move the complete stock a number of round boat trips, over a few days may be required, depending on the size of the fish to be transported and the distance from the producer to the recipient. This arrangement, rather than the engagement of many boats for the delivery of the stock from one farm to the other gives time for a staggered harvesting as well as for the recipient farmer to prepare the ponds between receipts of consignments. Accordingly (see Table 1), the mean number of trips to complete the delivery of a stock is 4.2 (±2.9) and the average total distance travelled to complete an operation is 71.23 (±6.27) km.

**Table 2**

Mean ± SE, range and coefficient of variation (CV) of relevant parameters in fry/fingerling transportation.

Parameter	Mean ± SE	Range	CV
Fry/fingerling per kg	3217 ± 682.8	730–16,000	0.95
Number of fry/fingerling per kg	52 ± 14.2	10–317	1.21
Number of fry/fingerling per trip	107,276 ± 10,539	4000–231,410	0.44
Transportation density (kg m <sup>-3</sup> )	104 ± 4.6	36.5–106.7	0.96
Transportation mortality			
3 h	117 ± 18.3	25–262	0.67
6 h	61 ± 9.4	0–135	0.69
9 h	2 ± 0.9	0–12	1.7

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