# The status of Basa fish *Pangasius bocourti* in cage culture in An Giang province, Vietnam

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***Abstract-*** Cage culture of Basa fish (*Pangasius bocourti*) in An Giang province was investigated through interview 55 households in Chau Doc city (20 households), Tan Chau (20 households) and An Phu districts (15 households). The collected information included general information of households, technical and financial variables in cage aquaculture. The results showed that each farming household had 3.36 cages with average volume of 623 $m^3$/cage. The high stocking density of 151 fish/$m^3$ leads to the high yield of 1,457 kg/10 $m^3$/crop in this kind of cage culture. After a culture period of around 10 months, the fish reached commercial size of 940 g/fish. The survival rate was high, 89.1%, and FCR was 1.85. The initial investment for cage farming was very high, in average of 19.8 million VND/10 $m^3$. Within one crop, the input cost was 33.3 million VND/10 $m^3$ and gained profit was 10.75 million VND/10 $m^3$ and the profit ratio was 0.32 times. The common challenges of Basa cage aquaculture were identified as polluted water, unstable farm-gate price and lacking investment capital.

***Index Terms***- An Giang, cage culture, *Pangasius bocourti*, technique

## I. INTRODUCTION

An Giang province, an upstream province of the Mekong River Delta in Vietnam which is dominated in aquaculture production. In 2017, people produced 361,332 tons aquatic products, accounting for 13.5% of aquaculture production in the Mekong Delta (General Statistics Office, 2018). The number of cages for fish production in An Giang increased from 2,294 cages (290,891 $m^3$) in 2008 to 5,244 cages (966,689 $m^3$) in 2016. The fish farming in cages in An Giang province was long time developed along rivers in all of districts and town such as Cho Moi district, Long Xuyen City, An Phu, Chau Thanh, Tan Chau Town and Chau Doc City. The main culture species were Basa fish (*Pangasius bocourti*), red tilapia (*Oreochromis* sp.), silver barb (*Barbonymus gonionotus*), snakehead (*Channa striata*) and giant snakehead (*Channa micropeltes*) (Fisheries Department of An Giang Province, 2017). Basa fish *Pangasius bocourti* was one of the dominated cultured species in cage in An Giang province, and it was found as favorable species cultured in An Giang province. In-depth research on *Pangasius bocourti* have been done e.g. seed production (Cacot *et al*., 2003), nutrition requirement (Hung *et al*., 2004), disease resistance (Van Doan *et al*., 2014; Meidong *et al*., 2018), and nutritional value (Thammapat *et al*., 2010). However, limit information on farming practice of Basa fish (*Pangasius bocourti*) cage culture, especially in An Giang province, Vietnam where the fish have been dominated. This study was conducted to evaluate the technical and financial efficiency of the *Pangasius bocourti* cultured in cage system in An Giang province to provide background information for the sustainable development of *Pangasius bocourti* cage aquaculture in the Mekong River.

## II. METHODS

The study was conducted from May 2018 to October 2018 at three selected sites with condensed cages including Chau Doc City, Tan Chau District and An Phu District in An Giang Province.

Secondary data was aggregated from the report of Department of Agriculture and Rural Development of An Giang province, Fisheries Department of An Giang province.

Primary data were collected by face to face interviews of households doing *Pangasius bocourti* cage culture. There were 55 households were interviewed, 20 households in Chau Doc town, 20 households in Tan Chau district and 15 households in An Phu district. Information was collected on the education background, years of experience in fish farming farm infrastructure e.g. total culture volume of cages, cages preparation. And information on farming practice was also asked i.e. fish feed, crop per year, stocking density, seed size, harvest size, yield, survival rate. Financial analysis included fixed cost, variable cost, total revenue,

profit and profit ratio. Information on the advantages and disadvantages of the farming model was also recorded.

After pilot testing of a draft questionnaire on two farmers, the final questionnaire was verified. The interviews were conducted by the main author and two trained interviewees together with a local authority representative. Technical and financial data were presented by frequency of occurrence, mean value, standard deviation, maximum value and minimum value. Differences in technical and financial efficiency between groups classified in volume of cages were tested through one-way ANOVA and Duncan test at a significance level of 95%.

## III. RESULTS AND DISCUSSION

### *3.1 General information*

Results showed that Basa fish cage culture farmers in An Giang province was 42.0 years old in average (Table 1). Farmers had an average of 4.0 years in Basa fish farming experience with maximum of 20 years and minimum of one year. The experience in Basa fish farming was mostly 1 - 4 years (70%), 5 - 8 years (18.3%), 9 - 12 years (10.0%) and 12-15 years (1.7%). The dominated of less experience farmers from Basa fish cage rearing is mainly due to the inherit of the second generation of people live in the region. In term of management, all farmers know how to operate the cage culture of Basa fish, however, long-term experience may have better management practice.

The number of labors in the household ranged from 1 to 9 persons, with an average of around 3 people per household, of which the average number of labors participating in the Basa fish cage culture was from 1 to 5 people per household. Besides, farmers also hired labors for Basa cage culture with the number of hired labor was 1 to 3 persons/household. The labor force participating in the Basa cage culture was mainly men (83.33%), because of heavy works required e.g. feed transport, feeding, harvest, diving to check the cage and cage caring.

There was no specialized aquaculture educated farmers operating the Basa cage culture in An Giang province. Many of them had secondary school (45%) and primary school (44%), the remaining were high school (3%) and illiteracy (8%). Compared to snakehead farming in the same region, it was a little bit higher in education level (Sinh and Chung, 2009). However, the limit educational level in Basa fish cage culture, the application of modern techniques was also limited. Thus, farmers need the support from local technical staffs on upgrade farming practice, especially on disease diagnosis.

### 3.2 *Cage culture production characteristics*

Basa fish farmers possessed many cages, 3.36 cages/household in average, maximum of 10 cages. The cage volume was 623 $m^3$/cage in average, maximum of 1,040 $m^3$/cage and minimum of 225 $m^3$/cage. The cage is of 16.2 ± 2.46 m average in length and 7.03 ± 0.96 m average in width and the average water depth was 5.35 ± 0.78 m. The cage for Basa fish culture in this study was a little bit bigger than cage for *Pangasius bocourti* culture previously described in Hong (2014) with an average volume of 578 $m^3$/cage, an average length of 15 m, an average width of 4.5 m and an average water depth of 4 m.

### *3.3 Cage culture farming practice*

At present, hatchery farms in An Giang province have been successfully to produce *Pangasius bocourti* fingerlings, satisfied the demand for seed supply. Basa (*Pangasius bocourti*) fingerlings at size of 61.9±4.29 g/fish was commonly stocked into cage at stocking density of 151±19.5 fish/$m^3$. This result was similar to the research result of Hong (2014) of 150 fish/$m^3$. The survival rate of *Pangasius bocourti* in this study was estimated of 89.1% higher than that of Long et al. (2014) with survival rates ranging from 83.3% to 88.7%. The total amount of feed provided for cages was on average 2,595 kg/10 $m^3$/crop. The feed used for *Pangasius bocourti* farming was mainly commercial pellet (86.0%). Some households used a combination of pellet feed and trash fish (10.5%) and few households only used home-made feed (3.9%). Home-made feed consists of 20% green vegetables, 50% rice bran, 30% trash fish, snails, mussels and minced fish heads. Therefore, FCR of each farmer was also different. FCR in the households using pellet feed alone was 1.85. The higher the FCR, the higher the production costs and reduce profits. Feeding by pellet feed reduced the impact on aquatic resource because trash fish mostly came from fishing inshore.

The rearing period to reach commercial size of 940±56.3 g/fish was around 10 months which longer than the culture period of *Pangasianodon hypophthalmus*, 6-8 months (Phan *et al*., 2009). Following the classification of cage volume into 225-500 $m^3$, 500-700 $m^3$ and 700-1040 $m^3$, the stocking density, survival rate and productivity of these 3 groups of cage volume were not significantly different ($p > 0.05$). With long term experience in basa culture, the high stocking density would increase Basa productivity (Table 4).

Table 1: Age, labor and number of years of experience of the Basa fish farmers

| Contents | Minimum | Maximum | Average |
|---|---|---|---|
| Age | 25 | 67 | 42 |
| Total number of labors on household (persons) | 1 | 9 | 3.25 |
| The number of labors from family member (persons) | 1 | 5 | 2.15 |
| The number of hired labors/employees (persons) | 1 | 3 | 1.51 |
| Years of farmer experience (years) | 1 | 20 | 4 |

Table 2: Cages for Basa fish culture

| Contents | Minimum | Maximum | Average |
|---|---|---|---|
| Number of cages (cages/household) | 1 | 10 | 3.36 ± 2.25 |
| Volume ($m^3$/cage) | 225 | 1,040 | 623 ±.199 |
| Length (m) | 10 | 20 | 16.2 ±.2.46 |
| Width (m) | 5 | 7 | 7.03 ± 0.96 |
| Water depth (m) | 4 | 6.5 | 5.35 ± 0.78 |

Table 3: Farming practice of Basa fish cage culture

| Contents | Value |
|---|---|
| Culture duration (days/crop) | 308±11 |
| Stocking density (fish/$m^3$) | 151±19.5 |
| Initial weight of fingerling (g/fish) | 61.9±4.29 |
| Harvesting weight of fish (g/fish) | 940±56.3 |
| Survival rate (%) | 89.1±5.14 |
| Productivity (kg/10 $m^3$/crop) | 1,457±174 |
| The total volume of feed used (kg/10 $m^3$/crop) | 2,595±472 |
| FCR | 1.85±0.13 |

Table 4: Comparison of technical parameters of *Pangasius bocourti* cultured in cage system

| | Cage volume groups | | |
|---|---|---|---|
| Contents | 225-500 $m^3$ | 500-700 $m^3$ | 700-1040 $m^3$ |
| | (n=15) | (n=23) | (n=17) |

| | | | |
|---|---|---|---|
| Stocking density (fish/$m^3$) | 147±19[a] | 152±13[a] | 151±21[a] |
| Survival rate (%) | 88.0±8.1[a] | 88.5±3.9[a] | 90.2±3.4[a] |
| Productivity (kg/10 $m^3$/crop) | 1,417±212[a] | 1,473±130[a] | 1,477±203[a] |

*Values of the same row with different letters were significantly different (p <0.05)*

*3.3 Financial aspects*

The total investment cost and average depreciation cost of the Basa cage aquaculture were 19.8 ± 4.36 million VND/10 $m^3$ and 0.41 ± 0.09 million VND/10 $m^3$/crop. The cost for building cage was the highest fixed cost, 19.2 ± 4.28 million VND/10 $m^3$ (accounting for 97% of total fixed cost). The cost of feed processor in cage using home-made feed was 0.51 ± 0.022 million/10 $m^3$ and the cost of transportation was 0.04 ± 0.015 million/10 $m^3$. The cost of building the cages accounted for the highest proportion which was similar to investigation of Tuyen (2012), the cost of cages was of 95.5%, 2.7% for machinery and 1.8% for transportation.

For total variable cost, it required 32.9 ± 5.44 million VND/10 $m^3$/crop, in which feed cost was 28.3 ± 5.08 million VND/10 $m^3$/crop (accounting for 86% of variable cost) and seed cost was 3.41 ± 0.44 million VND/10 $m^3$/crop (accounting for 10%). This result was also similar to the findings of Tuyen (2012), the feed costs accounted for 82.7% and the seed cost was 6.8%. This means the cost for operation of Basa cage culture was remained stable following years. The remaining costs accounted for a low proportion such as lime costs, fuel costs and labor costs. Total revenue of the Basa cage farming was 44.1 ± 5.45 million VND/10 $m^3$/crop. The profit was 10.7 ± 0.02 million VND/10 $m^3$/crop with net profit ratio reached 0.32 times. The selling price of commercial Basa was often unstable, depending on market demand. At the time of investigation, average selling price of Basa was 30,268 ± 761 VND/kg.

The financial analytical results from the three groups of cages showed that the profit and net profit ratios were not significant difference (p> 0.05). However, the average profit and net profit ratio of the group with cage volume above 700 $m^3$ was higher than that of others. This can be explained by the cost of constructing large cage was lower than that of small cages (p <0.05) and labor cost for large cages was also lower than that of small cages (p> 0.05) (Table 8 and 9).

Table 5: Fixed costs of Basa cage culture

| Contents | Fixed costs (million VND/10 $m^3$) | Number of years of use (years) | Depreciation costs (million VND/10 $m^3$/crop) |
|---|---|---|---|
| Cage | 19.2±4.28 | 50 | 0.38±0.08 |
| Feed processor | 0.51±0.22 | 15 | 0.02±0.01 |
| Transportation by boats to inland | 0.04±0.15 | 10 | 0.002±0.007 |
| Total fixed cost | 19.8±4.36 | - | 0.41±0.09 |

Table 6: Variable costs of Basa cage culture

| Contents | Value (million VND/10 $m^3$/crop) |
|---|---|
| Feed | 28.3±5.08 |
| Fingerling | 3.41±0.44 |
| Fuel costs | 0.46±0.13 |
| Labors | 0.44±0.24 |
| Lime | 0.26±0.12 |
| Others | 0.01±0.02 |

| | |
|---|---|
| Total variable costs | 32.9±5.44 |

Table 7: Financial efficiency of the Basa cage culture

| Contents | Value |
|---|---|
| Total revenue (million VND/10 $m^3$/crop) | 44.1±5.45 |
| Total cost (million VND/10 $m^3$/crop) | 33.3±5.42 |
| Profit (million VND/10 $m^3$/crop) | 10.75±0.02 |
| Net profit ratio (times) | 0.32±0.004 |
| Selling price (VND/kg) | 30,268±761 |

Table 8: Profit and net profit ratio of Basa cage culture following different cage volumes

| Contents | Cage volume groups | | |
|---|---|---|---|
| | <500 $m^3$ (n=15) | 500-700 $m^3$ (n=23) | >700 $m^3$ (n=17) |
| Profit (million VND/10 $m^3$/crop) | 9.02±3.79[a] | 10.41±3.63[a] | 11.18±4.11[a] |
| Net profit ratio (times) | 0.28±0.13[a] | 0.32±0.13[a] | 0.34±0.12[a] |

*Values of the same row with different letters were significantly different (p <0.05)*

Table 9: Cage cost, variable cost and labor costs of Basa cage culture following different cage volumes

| Contents | Cage volume groups | | |
|---|---|---|---|
| | <500 $m^3$ (n=15) | 500-700 $m^3$ (n=23) | >700 $m^3$ (n=17) |
| Building cage costs (million VND/1 $m^3$) | 2.38±0.50[a] | 1.94±0.26[a] | 1.77±0.37[b] |
| Variable costs (million VND/1 $m^3$/crop) | 3.29±0.65[a] | 3.32±0.56[a] | 3.28±0.56[a] |
| Labor cost (million dong/1 $m^3$/crop) | 0.059±0.033[a] | 0.038±0.25[a] | 0.039±0.10[a] |

*Values of the same row with different letters were significantly different (p <0.05)*

*3.4 Advantages and disadvantages*

*3.4.1 Advantages*

The geological location of An Giang province was favorable for fish farming in cages, full of river branches. This was a prerequisite, affecting the efficiency of fish farming. Therefore, many farmers think that they had opportunity to place their fish cages. Placement of cages must be within the planning area for aquaculture development issued from the provincial authority. Information included as (i) the bottom of cages must be at least 0.5 m away from the river bottom, (ii) cages placed in parallel must be at least 10 m apart, (iii) serial installation must be at least

200 m apart. The location of the cages is one of advantage of Basa farming claiming by many of farmers because of one-way flow of water from upstream, and there was no high tide amplitude. With great depth, it was convenient to place fish cages. Fishermen need to promote this advantage and comply with regulations on placing cages to make cage culture more effective and sustainable.

Another advantage was that river water from upstream flows downstream and brings about a lot of natural fish resources. Farmers could use this source for making home-made feed. In addition, the successfulness of artificial breeding of Basa fish had also contributed to the development of Basa cage aquaculture.

Table 10: The advantages of Basa cage aquaculture

| Contents | Number of observations | Ratios (%) |
|---|---|---|
| Appropriated site for placing cages | 35 | 64.4 |
| Available feed | 31 | 55.6 |
| Available seed apply | 22 | 40.0 |
| Not require high technology | 10 | 17.8 |
| High markets price | 6 | 11.1 |

*3.4.2 Disadvantages*

River water quality seems polluted. According to farmers, in addition to regular waste from thousands of cages, aquaculture ponds, residues of pesticides and fertilizers of agricultural land and untreated waste of aquatic processing plants have also made the water resource increasingly polluted. Polluted water increased fish disease and reduced productivity, influenced to farmers' income. The second challenge was that the farm gate price of Basa was not stable, fluctuated erratically, and being difficult for prediction. Many farmers invested in a large-scale farming model; unstable farm gate price led to reduced farmer's profit. This has affected the efficiency farming of Basa cage culture in recent years. The other challenge was lacking capital for investment that Basa fish farming required. The limited loan from local bank would reduce the expansion of the Basa cage culture in the area. Therefore, local governments should support fish farmer to access the loan from bank with acceptable interest rates. In addition, poor seed quality and frequent disease occurrence also influence to the Basa cage culture.

Table 11: The challenges of Basa cage aquaculture

| Contents | Number of observations | Ratios (%) |
|---|---|---|
| Polluted water | 33 | 60.0 |
| Unstable farm gate price | 28 | 51.1 |
| Lacking capital | 18 | 33.3 |
| Low quality seed | 9 | 16.4 |
| Frequent disease occurance | 6 | 11.1 |

## IV. CONCLUSION

Basa cage culture in An Giang is typical by high survival rate and stocking density 151 fish/$m^3$; productivity of 1,457 kg/10 $m^3$/crop at commercial size of 940 g/fish, culture for around ten months. The financial analysis results revealed that profit ratio was 0.32 times with several challenge need to be addressed. It would be proposed a proper management from the authority for sustainable development of this kind of cage culture production following the reduction of environmental impact, increase the livelihood of the farmer.

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