Status of major coastal fishing activities in the Mekong Delta, Vietnam

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Abstract- A study on the major fisheries was conducted from August 2017 to April 2018 in coastal provinces of the Mekong Delta, Vietnam. Results showed that the gillnets, trawl nets, and stow nets were the main fishing gears, accounted for the highest number of fishing boats and yields. All the fishing gears exploited for the whole year-round. The results also indicated that gillnets fishery is the largest scale (10.99 tons). The most effective fishing activity of gillnets fishy was the highest profit (298 million VND per year) ($p < 0.05$). However, the highest fishing yield (20.42 tons/year) was found in trawler but it had the lowest rate of return (0.45 times) and trash-fish portion accounted the highest ratio (38.4%). Although the stow nets had highest rate of return (1.41 times), but they were lowest yield (7.17 tons/year) and high portion of trash-fish. The high proportion of trash-fish may affect to fisheries resources. For the sustainable development of the fisheries in the Mekong Delta, the development and management of fisheries resources should be promoted, supporting fishermen to access low interest rates to invest in capture production, and training fishermen to use advanced fishing gear to increase their fishing efficiency.

Index Terms- challenges, fisheries, Mekong Delta, technique, economic, Vietnam

I. INTRODUCTION

The fisheries sector in Vietnam has developed strongly in recent years with the increase in production and product quality. In 2016, the total fisheries production was 6.8 million tons, of which the fishing production was 3.16 million tons, accounting for 46.4% of the total fisheries production, the export value of fisheries production was USD 7 billion. It contributes significantly to the GDP structure of the country (Ministry of Agriculture and Rural Development, 2016).

The Mekong Delta has a coastline of over 780 km, accounting for 23% of the national coastline, the exclusive economic zone of about 297,000 km^2. This area has a fish stock of over 2.5 million tons and the fisheries exploitation capacity is about 830,000 tons per year, which contributes to the fisheries development (Ninh, 2006). In 2016, the fisheries production in the Mekong Delta reached 1.286 thousand tons, accounting for 40.6% of the total fisheries production of the country (GSO, 2017). Fisheries in the Mekong Delta are diverse in types of gear and sizes which are mainly trawl nets, gill nets and stow nets because of the huge number of vessels and the fisheries production (Long and Phuong, 2010).

However, fisheries sector in recent years have encountered a lot of challenges e.g. reduction of fisheries resources, increase in the input cost of many materials and fuels, thus affecting the fisheries activities. The aims of the study are to investigate the current status and challenges of the fish activities in the Mekong Delta order to propose appropriate solutions to enhance the effective of the fisheries sector.

II. METHODS

The study was conducted from August 2017 to April 2018 by interview fishermen in coastal provinces of the Mekong Delta such as Tien Giang, Ben Tre, Tra Vinh, Soc Trang, Bac Lieu, Ca Mau and Kien Giang. A total of 365 fishing households was face to face interviewed. Fishermen involved in gill nets (150 households), trawl nets (150 households) and stow nets (65 households) were randomly selected from the list provided by provincial agriculture and rural development.

The semi-structured questionnaire was piloted in five households in each group of fishing type including technical information e.g. gear structure, loading capacity of the vessel, labor force, fishing grounds, fishing seasons and fishing production. Cost information included fixed costs, variable costs and gross income were also collected for calculation of profit, rate of return. The advantages and disadvantages of the fisheries were also interviewed.

Results are expressed in descriptive statistics e.g. frequency of occurrence, mean value, and standard deviation. Statistical ANOVA (SPSS 16.0) was applied to compare the

differences in technical and financial indicators following with the Duncan test at a significance level of α = 5%.

III. RESULTS AND DISCUSSION

3.1 Technical aspects of fishing activities in the Mekong Delta

3.1.1 General information of fishing activities

Results from the interview of fishermen in coastal provinces in the Mekong Delta, Vietnam showed that fishing gears were mainly gill nets (50.8%), longlines (16.8%), trawl nets (16.5%). Other fishing gears accounted for 16.8% including stow nets, cage traps, powered-push nets.

This study focuses only on the fishing activities of the main fishing gears such as gill nets, trawl nets and stow nets as these accounted highest volume and yield (Table 1).

The average age of fishing captains ranged from 39.8 to 45.1 years (Table 2).

Captains had in-depth experience in fishing due to long time working in the sector. Commonly, young people living in the coastal area participated in the fishing activities quite early at the age from 15 to 18 years old. This is the reason why captain had in-depth experience in fishing activities. However, due to participating in fishing activities early, many of them encountered many difficulties in terms of education leading to low education level.

Most of captains received primary and secondary education; higher education was very limited; there were even a few illiterate captains (Table 2). Consequence, the modernization of offshore fishing remained obstacles because of the adaptation in new fishing technologies, using modern equipment e.g. radar, positioning machine and fish finder. The low level of education of the captains also hinders the implementation of fisheries resource protection policies as well as the legal policies related to fisheries. Therefore, to modernize the fishing industry, it is necessary to improve the education level of captains.

Table 1: Number of fishing vessels (boats) in coastal provinces in the Mekong Delta, Vietnam

Contents	Coastal provinces in the Mekong Delta								
	Tien Giang	Ben Tre	Tra Vinh	Soc Trang	Bac Lieu	Ca Mau	Kien Giang	Total	Ratio (%)
Trawl nets	31	1003	341	415	161	34	132	2117	16.5
Gill nets	40	439	228	200	432	1981	3203	6523	50.8
Longlines	18	63	31	12	7	404	1618	2153	16.8
Other fishing trades (stow nets, cage traps, powered-push nets,..)	140	190	362	237	6	178	943	2056	16.0
Total	229	1695	962	864	606	2597	5896	12849	100

Table 2: Information on the age and education level of the captains

Contents	Gill nets	Trawl nets	Stow nets
Age (years)	42.6±9.9	42.7±11.3	45.1±9.9
Education (%):			
- Illiteracy	12.00	6.67	1.54
- Primary education	52.67	58.67	50.77
- Secondary education	30.67	30.67	40.00
- High school education	4.67	4.00	7.69

Table 3: Labor force (persons) in fishing boats

Contents	Gill nets	Trawl nets	Stow nets
Total number of labors on fishing boats	5.35±2.51[c]	3.55±1.25[b]	2.65±1.61[a]
The number of labors from family member	1.60±0.91[a]	1.74±0.85[ab]	1.91±0.97[b]
The number of hired labors/employees	3.75±2.50[c]	1.81±1.34[b]	0.74±1.04[a]

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

Table 4: Loading capacity and power of the fishing vessels

Contents	Gill nets	Trawl nets	Stow nets
Loading capacity (tons)	10.99±15.73[b]	5.54±2.44[a]	3.98±4.28[a]
Power (HP)	39.87±20.48[b]	37.54±16.24[ab]	20.72±15.41[a]

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

Table 5: Length and mesh size of fishing gears

Contents	Gill nets	Trawl nets	Stow nets
Length of the net (m)	8081±695	14.21±5.52	39.06±9.21
Width of the net (m)		0.92±0.08	11.21±2.54
Height of the net (m)	3.59±1.92	19.33±7.32	7.38±2.08
Smallest mesh size (mm)	61.35± 22.03	22.91±5.98	14.56±3.12

Results show that the labors in gill net fishing was higher than that of other occupations (p <0.05) because gill nets required more labors to pull the net (average length of 8 km). The lowest number of labors was found in the stow nets fishing which requires only 2-3 labors in one boat (Table 3).

The results in Table 3 show that the number of family labor engaged in fishing on fishing boats is only 1-3 workers. The remaining labors works had to be hired by more workers to ensure the fishing work on the fishing boats. The number of employees in the trawlers was higher than that of other fishing types (p <0.05). In general, the fisheries sector in the coastal provinces of the Mekong Delta provided jobs for the family members of fishermen and also for local people in the coastal area. However, the number of employees was unstable, and the lack of employees was frequent because most of these workers moved to occupational zones with better working conditions than on the sea.

3.1.2 Fishing vessels and fishing gear

Fishing vessels are mainly made by wood. Due to the in-shore fishing and the short time of the trip, many fishing vessels had small loading capacity, ranging from 3.98 to 10.99 tons. The loading capacity of gill net boats (8 km of the long net) was larger than other fishing types (p <0.05). The smallest loading capacity (3.89 tons) was found in the stow net because these boats were used only for carrying fisherman and fishing products in a short distance. Similarly, the machine horse power of stow net boats were smaller than the machine horse power of gill net boats and trawl net boats (Table 4) (p <0.05).

Gill nets, trawl nets and stow nets were different in shape and size. Gill nets had the longest length, following by trawl nets and stow nets (Table 5). The mesh size determines the size of the fish caught. The small mesh size prevents escapes of the juvenile fish, thus, affect the aquatic resources. According to the Ministry of Agriculture and Rural Development in Vietnam, the mesh size of the gill net had to be bigger than 44 mm, 28 mm for the trawl net and 20 mm for the stow net (Ministry of Agriculture and Rural Development, 2006). Following the rule, the mesh size in the trawl net and stow net in this study was smaller than the requirement. This is one of the reasons for declining of fishery resources. Therefore, it is necessary to have a strict management policy for these fishing activities.

3.1.3 Fishing grounds and fishing seasons

Fishing ground of fishermen in coastal province in the Mekong Delta are the sea areas from Vung Tau to Ca Mau and the Gulf of Thailand. The sea area from Vung Tau to Ca Mau had fish stock of 909,879 tons and the ability to exploit aquatic products was 425,952 tons. The Gulf of Thailand had a reserve of 478,689 tons and an exploitable capacity of 425,952 tons (Son, 2005). Both fishing grounds were favorable conditions for sustainable exploitation for the fishing sector in Mekong Delta, Vietnam. Fisheries activities could be taken place in the whole year, except bad weather. The number of fishing trips per year was more or less dependent on the duration of a trip, which is long or short. The results showed that the number of fishing trips in one month of trawl nets and gill nets were lower than in the stow nets ($p < 0.05$).

3.1.4 Fishing yield

Due to the characteristics of different fisheries activities in terms of scale and loading capacity, the yield of different fisheries activities should be different. Results showed that the trawl net had the highest yield (592 kg/HP/year) following by the gill net (506 kg/HP/year) ($p < 0.05$). According to Long and Phuong (2010), the yield of trawls and gill nets were 0.46 tons/HP/year and 1.02 tons/HP/year, respectively. This result shows that the yield of gill nets currently tends to decrease. In another hand, Nhien and Dinh (2012) reported that the productivity of marine fisheries decreased by 38.2%. In-shore fishing along the coastal line surely reduces the fisheries resources, thus there is an urgent need to promote offshore fishing for fishermen in coastal provinces in the Mekong Delta, Vietnam. The trash-fish ratio in the fishing products was different among fishing types, depending on the fishing characteristics. Results show that the ratio of trash-fish in different fishing types was statistically significant ($p<0.05$), in which the highest ratio of trash-fish was found in the trawl nets and the lowest one was in gill nets (Table 7). Previous study revealed that in single trawl net and gill net, the ratio of trash-fish of fishing production in offshore fishing was lower than that of near-shore fishing (Long, 2014). This implies that the development of offshore fishing increases the catching productivity while reducing the pressure on the shoreline fisheries, thus reducing the impact on fisheries resources.

Table 6: Fishing schedule of different fishing types

Contents	Gill nets	Trawl nets	Stow nets
Time of fishing batch (hours)	4.59 ± 3.31^{b}	3.21 ± 0.76^{a}	4.97 ± 1.07^{b}
The number of fishing batch in a day (batch)	1.91 ± 0.94^{b}	3.36 ± 0.62^{c}	1.24 ± 0.43^{a}
The days in a fishing trip (days)	6.75 ± 1.66^{c}	4.96 ± 1.03^{b}	1.02 ± 0.12^{a}
The fishing trip in a month (trips)	3.00 ± 0.40^{a}	2.99 ± 0.59^{a}	20.27 ± 6.07^{c}
The fishing month in a year (months)	8.55 ± 0.85^{a}	9.61 ± 2.07^{b}	10.09 ± 2.16^{c}

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

Table 7: Exploitation yields of different fishing types

Contents	Gill nets	Trawl nets	Stow nets
Yield (kg/trip)	612 ± 109^{b}	724 ± 218^{c}	39 ± 15^{a}
Production (tons/year)	15.68 ± 3.86^{b}	20.42 ± 7.64^{c}	7.17 ± 2.33^{a}
Productivity (kg/HP/year)	506 ± 297^{a}	592 ± 214^{b}	-
Ratio of trash-fish (%)	13.8 ± 2.94^{a}	38.4 ± 15.1^{c}	30.9 ± 6.6^{b}

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

3.2 Financial aspects of fishing activities in the Mekong Delta

3.2.1 Costs of fishing activities in the Mekong Delta

The initial cost of fishing activities are mainly the purchase of boat hulls, engines and fishing gear (fixed costs). Depending on the fishing types, their cost ratios are different. The results showed that the highest costs were for buying boat hulls and gears for gill nets fishing; for trawl nets, the highest costs were for buying boat hulls and engines, and for stow nets fishing was of purchasing fishing gears (Table 8). There was a statistically significant difference in the fixed costs between fishing activities ($p < 0.05$). The fixed costs of gill net fishing were the largest (425.1 million VND), following by trawl net (VND 157.6 million) and stow net (VND 27.7 million).

Depending on the age of the boat hull, engine, fishing gear and the number of fishing trips per year, the depreciation cost between fishing activities was different. Results showed that the depreciation cost of fishing types were significantly different ($p<0.05$), in which gill nets had the highest depreciation cost and stow nets had the lowest depreciation charge (Table 8).

Variable costs included all costs related to fishing operations. These expenses included fuel, ice, salt, food and labor costs. Table 9 shows that variable costs of fishing types are mainly fuel and labor costs. Depending on the characteristics of each fishing types, the ratio of these costs was high or low. For trawls net fishing, fishing vessels operated during catching fishing, so fuel costs accounted for the highest rate (43.43%), while in the other fishing types, the labor cost accounted for the highest ratio. However, the cost of fuel of remain fishing types is also high. When the price of fuel increased, it greatly affected the profitability of the fisheries sector. Therefore, the establishment of fishing teams/groups and increase the transporting fishing products team will help reduce fuel costs and get higher profits.

Table 8: Fixed cost and depreciation of fishing types

Contents	Gill nets	Trawl nets	Stow nets
Fixed cost (*million VND*)	425±29^{c}	157±54^{b}	27.7±3.8^{a}
In which:			
Cost of buying hull (*million VND*)	150±22	101±44	5.7±1.4
Cost of buying engine (*million VND*)	59±10	47.1±39	8.8±2.8
Cost of purchasing fishing gear (*million VND*)	209±16	8.8±7.2	13.2±1.3
Bank interest (*million VND*)	7.1±2.0	0.6±0.2	
Depreciation cost (*million VND/trip*)	5.08±1.13^{c}	0.67±0.69^{b}	0.03±0.02^{a}

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

Table 9: Variable cost structure of fishing types

Contents	Gill nets	Trawl nets	Stow nets
Variable cost (*million VND/trip*)	17.02±8.88^{c}	13.32±6.90^{b}	0.93±0.58^{a}
In which:			
Fuel (*million VND/trip*)	3.44±1.77	5.79±3.30	0.18±0.14
Oil (*million VND/trip*)	0.83±1.38	1.10±0.63	0.03±0.03
Food (*million VND/trip*)	2.26±0.82	1.85±1.06	0.13±0.08
Ice (*million VND/trip*)	0.57±0.60	0.87±0.49	0.03±0.02
Labor cost (*million VND/trip*)	8.40±3.97	3.27±1.73	0.53±0.32
Maintenance costs (*million VND/trip*)	1.30±2.17	0.35±0.42	0.01±0.01
Other cost (*million VND/trip*)	0.22±0.92	0.10±0.22	0.01±0.00

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

3.2.3 Financial performance of fishery capture

Table 10 shows that the profit of gill nets was 10.9 million VND/HP/year and it was significantly higher than that of trawl nets (4.27 million VND/CV/year). Rate of return of the fishing types was not high because of the high operation cost and low gross income, except the stow net because of the low operation costs. Compared to the research results of Long and Phuong (2010), the rate of return of the trawl nets decreased significantly. The rate of return of the trawl nets in 2010 was 0.51 times and reduced to 0.45 times in 2017. However, compared to the results of Truong *et al*. (2016), the rate of return of trawl nets in the Mekong River Delta was much higher than that of in Nha Trang province, middle region of Vietnam (0.02-0.06 times).

Compared to other aquaculture activities, for example, white leg shrimp culture in Ca Mau with a rate of return of 1.66 times (Long and Hien, 2015), the black tiger shrimp culture with rate of return of 1.1 times (Long, 2016) and the model of eel farming in Ca Mau with a rate of return of 1.43 times (Long and Hai, 2014). This shows that fishing activities in the Mekong Delta is not as effective as other activities.

The results on financial analysis showed that the fuel cost in fisheries accounted for a high proportion. When the fuel price increased, the production cost increased quickly. However, the selling price of fishery products increased slowly, reduced the gross income, hence reduced rate of return. On the other hand, when the fishery resources decline, the fishery production also decreases, which in turn affects the gross income and rate of return. To gain more in rate of return, it is necessary to have solutions and policy on control the fuel costs and preserve good products at high quality for higher prices. Therefore, the linkage of production and transportation of fishery products may reduce fuel costs, enhance the fisheries products quality for the higher prices and increase gross income. Good fisheries management also contributes to high fishing efficiency and high gross revenue.

3.3 Advantages and disadvantages

Fishing activities in the Mekong Delta are still attractive due to many vessels doing fishing at favorable conditions for fishing ground, labor availability and in-depth experience fishermen. Fishermen tried to follow up with fishing activities and they did not like to convert to other occupations. The short duration of fishing trip should be suitable for investment of fishermen. Besides advantages, trawls, gill nets and stow nets also encountered many difficulties. High production costs affected the income of fishermen. Lacking capital was also a problem for fishermen. Many fishermen had to borrow money for fishing activities at high rates of interest leading to reduce profits. Unpredictable weather affected fishing season, resulting in unstable production, which affected the income of fishermen.

To facilitate the sustainable development of fisheries, works have to be done including (i) strengthening the management and development of fisheries resources such as the development of near-shore fishing boats, force the mesh size following to regulations, banned fishing during the breeding season... (ii) providing favorable policy conditions for fishermen to access bank capital at low interest rates for investment in production (iii) training fishermen to use equipment such as fish detector to find fish quickly, exploit effectively in bad weather conditions.

The research results show that gill nets, trawl nets and stow nets can be exploited all the year round. The boats of trawl nets and stow nets are small loading capacity, and the loading capacity of gill net vessels is larger. The yield of the trawl nets is the highest, following to the gill net and stow nets. However, the ratio of trash-fish in trawl net is the highest and the stow nets is the second one. The rate of trash-fish in the gill net is the lowest. This shows that trawl net and stow net greatly affect the fisheries resources. On the other hand, in terms of the smallest net mesh size of the gears, the net of trawl nets and stow nets fishing have mesh size to be smaller than stipulated, thus contributing to the reduction of fisheries resources. For the sustainable development of fishing activities in the Mekong Delta, it is necessary to restrict or improve the effectiveness of fishing activities which have a great impact on aquatic resources such as trawl nets and stow nets. In terms of financial efficiency, the results show that the gill net profit is the highest. This proves that gill nets operate more effectively than others. Therefore, offshore fishing or gill nets fishing type should be strengthened and enlarged to fishing activities in the Mekong Delta, Vietnam.

Table 10: Financial analysis of fishing types

Contents	Gill nets	Trawl nets	Stow nets
Gross income (*million VND*/trip)	33.7 ± 6.0^{c}	17.4 ± 5.2^{b}	1.95 ± 0.8^{a}
Total cost (*million VND*/trip)	22.1 ± 8.6^{c}	12.4 ± 4.5^{b}	0.96 ± 0.6^{a}
Net return (*million VND*/year)	298 ± 143^{c}	138 ± 62^{a}	200 ± 88^{b}
Net return (*million VND*/HP/year)	10.9 ± 9.27^{b}	4.27 ± 2.4^{a}	-

Rate of return (times)	0.62 ± 0.31^{b}	0.45 ± 0.21^{a}	1.41 ± 0.70^{c}

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

IV. CONCLUSION

Gillnets, trawl nets and stow nets are major fishing gears that accounting for the highest number of boats and production in the Mekong Delta. Fishing activities can be done year-round. The capacity of gill net boat was the largest (10.99 tons) ($p < 0.05$) and the yield of trawler was the highest (20.42 tons / year) ($p < 0.05$). Due to the large mesh size of gillnets so the trash-fish had the lowest proportion (13.8%) ($p < 0.05$). The net return of gill nets was the highest (298 million VND / year) ($p < 0.05$) and the rate of return was quite high (0.62 times). The trawler had the highest yield (20.42 tons/year) ($p < 0.05$) but it had the high trash-fish ratio (38.4%) and the lowest rate of return (0.45 times). Stow nets had the highest rate of return (1.41 times) but it had low yield (7.17 tons/year) and high trash-fish ratio (30.9%), so this may affects fisheries resources. The main problems of the coastal fisheriesare the lack of capital and erratic weather affecting fishing. In the future, it should be limited to the development of trawler, which will be turned into gill net or offshore exploitation so that fisheries exploitation will be oriented to sustainability.

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