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Small-scale Trawl and Gillnet Fisheries in the Vietnamese Mekong Delta

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ABSTRACT

To obtain insights into small-scale fishing activities in the Vietnamese Mekong Delta, 180 trawlers and 180 gillnets fishing households were interviewed. Furthermore, 30 fish merchants were interviewed to understand the fish channel market, while economic fish species composition was determined through the sampling of 30 trawlers and 30 gillnets households. The results showed that both trawl and gillnet fishing operated throughout the entire year. The trawl fishing vessels cover significantly longer time trips (1.9 days) on average compared to the gillnet vessels (1.5 days). Fishing yield calculated per HP of trawlers (0.895 ton/HP/year) was seven times higher than that of the gillnets (0.128 ton/HP/year). The percentages of bycatch in both trawler and gillnet were found to be lower in relation to a previous study. This would suggest that the economic efficiency of trawlers and gillnets has improved. A large proportion of total fish was sold to traders/wholesalers and then transported to processing factories and later sold to the retailers at local markets. The caught economic fish species from the two fishing activities showed typical species assemblages representative of fishing gears. Inclement weather and lack of capital were two of the main highlighted constraints for fishing livelihood survival.

INTRODUCTION

Aquatic resource depletion has been observed in many coastal areas of South East Asian countries such as Malaysia, the Philippines and Thailand. Thus, an urgent need is emerging for countries to reduce and manage their fishing capacities **(Stobutzki *et al.*, 2006)**. Vietnam has a long coastline and favorable conditions for the development of fishery exploitation. In 2017, the total Vietnamese fishery production was 7.23 million tons, of which the exploitation production was 3.39 million tons, accounting for 46.9% of the total fishery production. The export value of fishery production accounted for 8.3 billion USD, significantly contributing to the GDP structure of the country **(GSO, 2018)**. However, fishing activities are facing challenges, including the decline of aquatic resources and the implementation of changing fishery management policy. An integrated food web model that was run to test the impact of fisheries management scenarios on the coastal ecosystem of Vietnam with an estimation reduction of 20% fishing from fish and shrimp trawl or gillnet and purse seine fishing addresses a 10% biomass reduction in

several key functional groups **(Anh *et al*., 2014)**. Various recommended actions for small-scale fisheries in Vietnam have been proposed such as, improving catch statistics, resources for provincial fisheries staff, and a coordinated and integrated approach involving a mixed strategy of resource management, resource restoration, economic and community development, and new governance arrangements **(Pomeroy *et al*., 2009)**.

The Vietnamese Mekong Delta has a long coastline, which has promoted the development of the fisheries industry. In 2017, fishery production in the Vietnamese Mekong Delta reached 4.05 million tons; 56.0% of the total fishery production of the country **(GSO, 2018)**. Fishing gears in the Vietnamese Mekong Delta vary in type and size, and consist mainly of trawlers and gillnets **(Long & Phuong, 2010)**. The majority of fishing vessels are mechanized with less than 90 HP and operate in inshore areas with water depth less than 50 m **(Pomeroy *et al*., 2009)**. The dominant fishery gear in use is small gillnet, small trawl, longline, push net, small lift nets with lights, and traps. Gillnet fishing in Nha Trang, central Vietnam reflects the fishing effort of vessels in the production through engine capacity (HP), gear size and days of fishing **(Duy *et al.,* 2012)**. The catch of gillnet contributed greatly to the total catch of all fisheries and achieved an estimation of 31% of the total catch **(Anh *et al*., 2014)**. A large number of small capacity fishing boats with different fishing gears in the Vietnamese Mekong Delta are greatly affecting fisheries resources due to the in-shore fishing. Thus, this study that was conducted on the fishing activities of small-scale trawls and gillnets aimed to provide some fishing technical informations and produce efficiency indicators for better management of the industry.

MATERIALS AND METHODS

The study was carried out from May to December 2018 in six coastal provinces of the Vietnamese Mekong Delta; namely, Ben Tre, Tra Vinh, Soc Trang, Bac Lieu, Ca Mau and Kien Giang (Fig. 1). Both trawl and gillnet are two important occupations for the local fishing industry in the Vietnamese Mekong Delta. Therefore, this study focused on the fishing activities of trawl and gillnet with engine capacities ranging from 20 HP to less than 90 HP which is defined as small-scale fishery.

A total of 180 fish trawl households (30 in each province) and gillnet households (180) were randomly selected from the list provided by the local authority. Households were interviewed following semi-structure questionnaires including information of fishing season, fishing yield, financial efficiency, advantages and difficulties. Furthermore, 30 fish merchants were interviewed to determine fish channel markets. For illustration, fish composition from the catches of both trawl vessels (five in each province)

and gillnet vessels (five in each province) were determined through samples collection and fish identification. This was performed following the procedures of **Dinh *et al.* (2013)**. The percentage shares of individual fish species were calculated through the total weight of each fish species over total fish caught from each vessel.

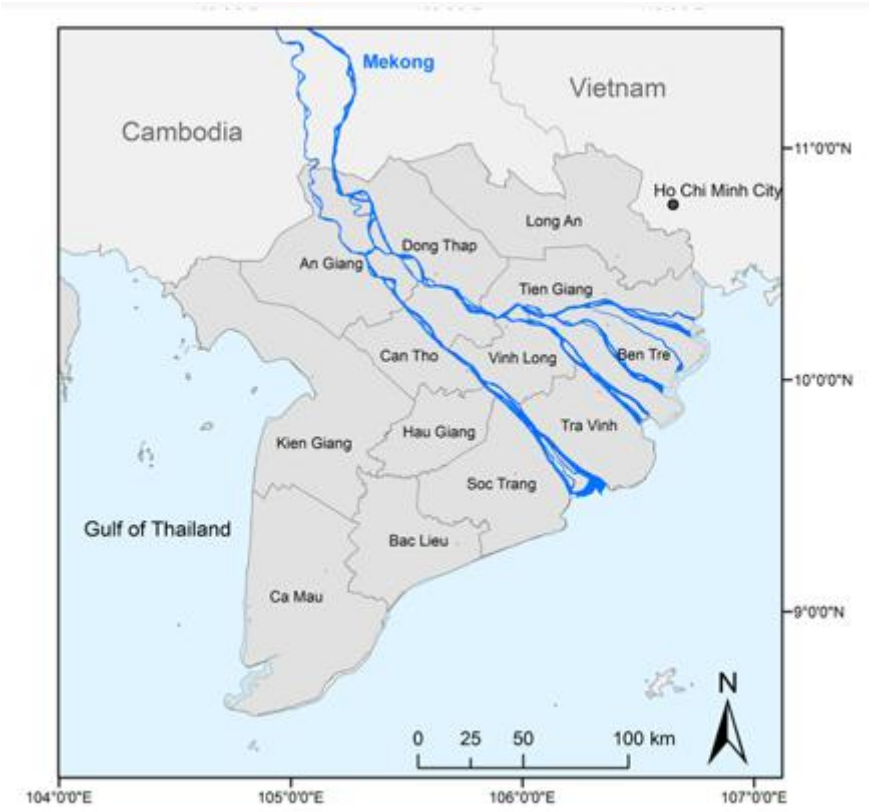

Fig. 1. Map of the Vietnamese showing Mekong Delta

Results were expressed in descriptive statistics, including frequency of occurrence, mean value, and standard deviation. Statistical independent sample t-test was applied to compare the differences in technical and financial indicators with a significance level of 95%.

RESULTS

1. Fishing activities of trawl and gillnet

The trawl and gillnet fishing in the Mekong Delta are heavily used in both the East and the West Sea waters, especially the fishing grounds from Vung Tau to Ha Tien. The trawl fishing vessels consume significantly longer time for each trip (1.9 days) compared to the gillnet vessels (1.5 days) ($p<0.05$) (Table 1). Commonly, for fishing activities, trawl fishing vessels consume 8.9 months, whereas gillnet vessels cover a period of 9.1

months over the course of a year. Trawl and gillnet fishing operate all year-round, except in the case of bad weather (Fig. 2, 3). Trawl fishing dominates from October to April, whereas the remaining months were dominated by the gillnet fishing. Fishing yield of trawl vessels was significantly higher than those of gillnet, with an average yield per catch of 48.8 kg compared to 18.0 kg. Additionally, fishing yield calculated per HP of trawlers was seven times higher than that of the gillnets ($p<0.05$) (Table 2).

Table 1. Fishing schedule of fishing gears

Contents	Trawlers (n=180)	Gillnets (n=180)
Time of fishing batch (hours)	3.4±0.6[a]	4.2±3.9[b]
The number of fishing batch in a day (batch)	3.2±0.6[a]	1.0±0.0[b]
Duration of fishing trip (days)	1.9±1.2[a]	1.5±0.6[b]
Number of fishing trip per month (trips)	16.6±7.9[a]	18.5±4.9[a]
Number of months per year (months)	8.9±1.7[a]	9.1±1.4[a]

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

Table 2. Fishing yields of trawler and gillnet

Contents	Trawlers (n=180)	Gillnets (n=180)
Yield (kg/batch)	48.8±8.50[a]	18.0±8.40[b]
Production (tons/year)	39.5±15.9[a]	3.35±2.22[b]
Productivity (kg/HP/year)	895±186[a]	128±83[b]
Ratio of bycatch (%)	23.4±8.60[a]	12.5±3.90[b]

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

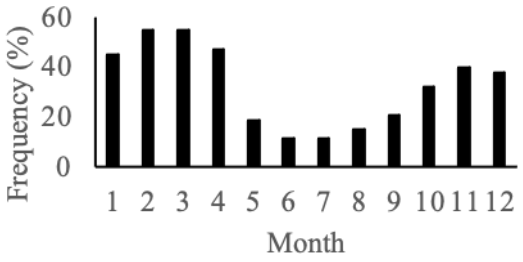

Fig. 2. Fishing season of trawlers

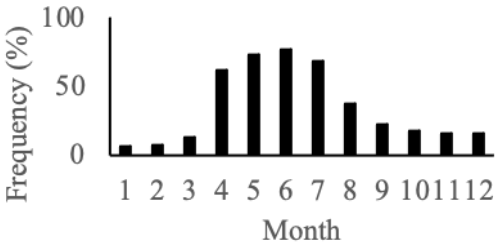

Fig. 3. Fishing season of gillnets

2. Economic pattern of trawler and gillnet

The investment cost for a trawl boat required 12,826 USD as an average, in which 73.5% was for the hull, 15% for the engine, and 7.2% for the fishing gear. For gillnet boats, the hull, engine and gear were also the main fixed costs (Table 3). In terms of operational costs, both the trawler and the gillnet showed similar costs for fuel and labor. The gross income of the trawler per unit per year was 39,435 USD and 16,478 USD for the gillnet. The net return per HP per year of the trawler was significantly higher than that of the gillnet ($p<0.05$). In contrast, the rate of return for the trawler (0.64 times) was significantly lower than that of the gillnet (0.81 times).

Table 3. Fixed cost and operation cost of fish trawling and gillnet

Contents	Trawlers (n=180)		Gillnets (n=180)	
	Average	Ratio (%)	Average	Ratio (%)
Fixed cost (*USD*)	12,826±11,043[a]	100	7,913±3,434[b]	100
- Ship hull	9,434±4,739	73.5	4,609±2,174	56.1
- Engine	1,921±634	15.0	869±461	10.8
- Fishing gear	930±382	7.2	1930±932	23.4
- Other cost	552±234	4.3	474±178	5.7
Depreciation cost (USD)	1,361±509[a]		1,917±713[b]	
Operation cost (*USD*)	22,695±8087[a]	100	7,173±2,565[b]	100
- Fuel	9869±1478	43.5	3,004±621	41.9
- Oil	721±226	3.2	143±61	1.9
- Food	2069±500	9.1	935±335	13.0
- Ice	478±178	2.1	69±52	0.9
- Labor cost	8173±3869	36.1	2,709±739	37.8
- Maintenance costs	773±152	3.4	261±61	3.6
- Other cost	574±95	2.6	52±4	0.74
Total cost (*USD*)	24,043±8,304[a]		9,087±2,956[b]	
Gross income (*USD*)	39,435±12,435[a]		16,478±6,826[b]	
Net profit (*USD*)	15,391±4,956[a]		7,391±3,174[b]	
Net return per HP per year (*USD*)	334±91[a]		282±100[b]	
Rate of return (*times*)	0.64±0.37[a]		0.81±0.47[b]	

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

3. Market channel of the catch

A large proportion (96.94%) of the total fishery products from the gillnet was sold to traders/wholesalers and then transported to processing factories (49.48%), sold to retailers in local markets (45.20%) or sold to the retailers in the markets of other provinces (2.26%) (Fig. 4).

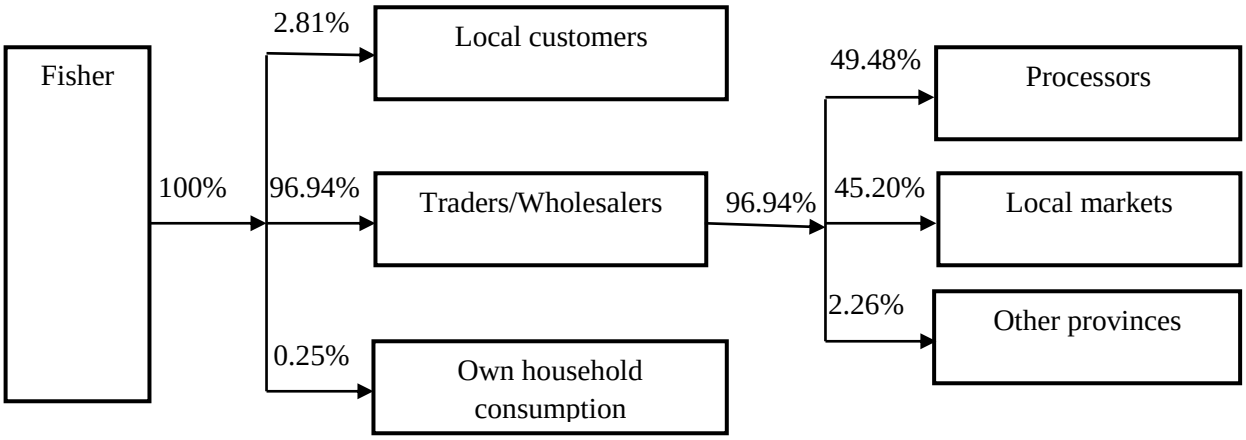

Fig. 4. Market channels for seafood products of gillnets

The remaining proportion was sold directly to local customers (2.81%) or consumed within family (0.25%). Similarly, the harvested products of the trawlers were sold mainly to traders (90.48%) (Fig. 5). An average of 9.52% of the total catch was used directly for household consumption (including gifts to relatives and hired labors).

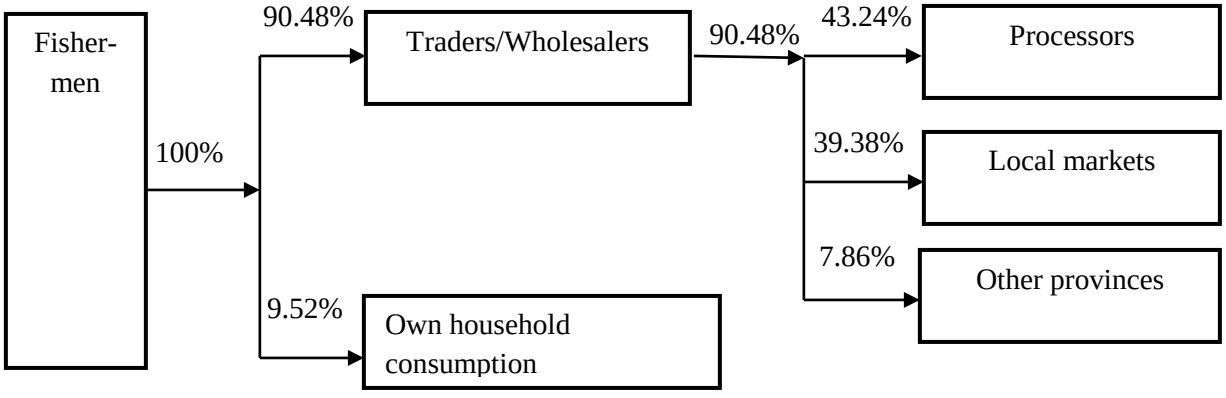

Fig. 5. Market channels for fishery products of trawlers

4. Advantages and difficulties of trawl and gillnet fishing activities

Small-scale households involved in trawlers and gillnets fishing activities in the Vietnamese Mekong Delta reported several advantages and difficulties. Firstly, fishing activities has a long history in the region, thus, having households exhibit a wealth of experience and knowledge of fishing practices (Table 4).

Table 4. Advantages and difficulties of trawlers and gillnets

Responses	Trawlers		Gillnets	
	n	Ratio (%)	N	Ratio (%)
Advantages				
Experience in fishing	126	70.0	146	81.1
Stable income	65	36.1	83	46.1
Living near the sea (fishing ground)	42	23.3	26	14.4
Stable output of fishing products	-	-	36	20.0
Difficulties				
Fishing grounds competition	111	61.7	111	61.7
Inclement weather	35	19.4	147	81.7
Declining production	67	37.2	79	43.9
Cost of production increased	46	25.6	32	17.8
Labor shortage	37	20.6	50	27.8
Net loss		-	43	23.9
Lack of capital		-	75	41.7

However, less than half of both trawler and gillnet fishermen reported that the career had a stable income for their living expenses. Gillnet fishermen reported that the stable output of fishery products was an advantage for the career. However, trawlers and gillnets households were facing some difficulties. The biggest problem was that other fishing gears competed for their fishing grounds which affected the aquatic resources. Moreover, the inclement weather was a great difficult for the gillnet fishermen (81.7% reported) which heavily affected their income. In addition, both the net profit loss and the lack of capital for production were reported as big challenges for gillnet fishermen. Their

return was low and variable while there were few ways to obtain sufficient credit and capital to invest.

5. Fish species composition from trawl and gillnet catch

Overall, a total of 34 economic species were identified in the catch of trawl fishing including 22 species of marine fish, seven shrimp species (23.08%), four cuttlefish species (35.68%) and one sweet snail (1.04%). Perciformes dominated, 12 species (17.65%), followed by Clupeiformes, Myliobatiformes, Pleuronectiformes, two species (16.01%) and Anguilliformes, Gasterosteiformes, Scorpaeniformes, Tetraodotiformes, one species (5.71%) of each order. Some economic species exploited by trawl fishing are presented in Table (5). In gillnet fishing catch, 27 economic species were identified including 22 marine fish species, four crustacean and one cuttlefish species. The dominant marine fish species caught was Perciformes with 15 species (17.33%), followed by Pleuronectiformes and Tetraodotiformes with two species of each order (7.92%) and Myliobatiformes and Clupeiformes and Characiformes of one species (24.93%) of each order (Table 6).

Table 5. Economic fish species exploited by trawl fishing

No.	Species	Percentage (%)
1	*Loligo chinensis* (Gray, 1849)	18.0
2	*Batepenaeopsis tenella* (Spence Bate, 1888)	8.4
3	*Sepia aculeata* (Van Hasselt, 1835)	6.4
4	*Amphioctopus aegina* (Gray, 1849)	6.4
5	*Xiphias gladius* (Linnaeus, 1758)	5.9
6	*Pseudorhombus arsius* (Hamilton, 1822)	5.6
7	*Charybdis natator* (Herbst, 1794)	5.1
8	*Atrobucca nibe* (Jordan & Thompson, 1911)	4.7
9	*Penaeus semisulcatus* (De Haan, 1844)	4.2
10	*Nemipterus marginatus* (Valenciennes, 1830)	3.6
11	*Escualosa thoracata* (Valenciennes, 1847)	3.7
12	*Hemitrygon bennettii* (Müller & Henle, 1841)	3.3
13	*Nibea coibor* (Hamilton, 1822)	3.2

14	Other species	21.5
	Total	100

Table 6. Economic fish species exploited by gillnet fishing

No.	Species	Percentage (%)
1	*Portunus pelagicus* (Linnaeus, 1758)	44.8
2	*Xiphias gladius* (Linnaeus, 1758)	12.7
3	*Grammatorcynus bilineatus* (Rüppell, 1836)	11.1
4	*Pseudorhombus arsius* (Hamilton, 1822)	6.7
5	*Rastrelliger brachysoma* (Bleeker, 1851)	6.0
6	*Nemipterus marginatus* (Valenciennes, 1830)	3.2
7	*Megalaspis cordyla* (Linnaeus, 1758)	2.4
8	*Sepia aculeata* Van Hasselt, 1835	1.6
9	*Nibea coibor* (Hamilton, 1822)	1.6
10	*Charybdis natator* (Herbst, 1794)	1.6
11	*Sillago sihama* (Forsskål, 1775)	1.2
12	*Atule mate* (Cuvier, 1833)	1.2
13	Other species	6.0
	Total	100

DISCUSSION

The activities of trawl fishing has witnessed a slight change in comparison to a previous study. **Long *et al*. (2014)** reported that fish trawling journey took typically 5.1 days, however this study found an average duration of 1,9 days. This can be explained by the near shore fishing, as well as the fact that fishing has increased the competition between fishing fleets and fishing grounds. It was noted, in the fishing grounds located in the waters surrounding Vietnamese Mekong Delta, that fishing is conducted at a depth of 10–40 m and not more than 50 m off the coast **(Pomeroy *et al*., 2009)**. For gillnet, the fishing voyage has remained unchanged due to the low HP vessels, taking one to two days for each fishing trip. In general, both small-scale fishing gears spent less time for

each trip to optimize the economic pattern (section 3.2). The fishing seasons of the trawl and gillnet are not similar, and it seems to be a seasonal career (Fig. 1, 2). It could be suggested to switch trawl fishing to gillnet and vice versa to increase fishing efficiency. The trawler fishermen can switch to gillnet by changing nets at the months trawling is not efficient

Fishing yield calculated per HP of trawlers (0.895 ton/HP/year) was seven times higher than that of the gillnets (0.128 ton/HP/year). The single trawling vessels were seen in the study area to increase the productivity, while the gillnet remained similar in comparison to previously reported results (**Long, 2014; Thuong *et al*., 2014**). This suggests that the trawl and gillnet fishing activities have become more efficient because of installation of modern equipment **(Duy *et al*., 2012; Anh *et al*., 2014)**. However, according to the interviewed fishermen, the fishing yield has gradually decreased over the last 5 years. Therefore, better management of both trawl and gillnet fishing would contribute to limit the impact of fishing activities on aquatic resources. Remarkably, the gillnet is a fishing gear which has high selectivity and is less likely than trawl to damage the sea floor **(Duy *et al*., 2012)**. Although the fishing yield of trawl was higher than that of gillnet, the trawl fishing is a non-selective fishery, because catching all fish species with many different sizes would lead to a high bycatch (23.4%). The gillnet is a selective catching, thus the bycatch is lower (12.5%) ($p<0.05$) (Table 2). Compared to previous studies, the rate of bycatch in trawler and gillnet has reduced; in 2013 the reported bycatch was 51.7% and 23.6%, respectively **(Long, 2014)**. The reduction of bycatch in fishing not only improves the economic return, but also reduces the decline of aquatic resources.

The economic efficiency of trawlers and gillnet in this study has been improved. The trawler's profit has improved significantly in comparison to the results of **Long and Phuong (2010)**. This pattern was also similar to the case of the gillnets, as the rate of return was 0.81 times, while profitability of the gillnets in Soc Trang province was 0.46 times **(Long, 2012)**. The average cost, net return, net return per HP of trawlers, were significantly higher than those of the gillnets. Eventually, gillnets became more efficient than trawlers because of a higher rate of the return of the gillnets (0.81 times). The composition of possible revenue increments is a reason for the economic inefficiency of trawl fishing activities **(Lindebo *et al*., 2007)**.

A previous study revealed that most fishery products were sold directly to traders (81.6% of the total catch), and to the processing factories (4%), while the remaining were used for household consumption as gifts or sold directly to the local customers **(Ven, 2012)**. Because of their capacity to buy all fish catch in a short-time, fishermen often chose to sell their products to traders. This is convenient for fisherman who save time and budget to get prepared for the next trip. However, fishermen could not dictate the selling price and are dependent traders, which often lead to low profit margins..

Results from another study in 2018 reported that, the greatest market channel for fishery products of trawlers was 100% bought by traders and then resold to wholesalers in the whole-sale markets, which accounted for 69.37% of total products **(Phuong *et al*., 2018)**. In general, the harvested product price was affected directly by traders. Hence, having more competitive prices for fishery products, the local government should create platforms for many new traders operating.

Small-scale trawlers (<90 HP) mainly exploited shrimp, whereas trawlers with bigger vessels (>90 HP) target finfish, squid and others **(Nguyen, 2013)**. In this study, the trawler with fishing capacity below 90 HP, were seen to exploit mainly cuttle fish, such as *Loligo chinensis*, *Sepia aculeata* and *Amphioctopus aegina*, accounting for 30.4%. The gillnet fishing mainly exploited blue swimming crab (*Portunus pelagicus*) and pelagic fish, e.g. *Xiphias gladius*, *Grammatorcynus bilineatus*, *Pseudorhombus arsius*, and *Rastrelliger brachysoma*. In this study, the capture of sea turtles and marine mammals was not seen. The current finding is in agreement to previous study reporting that, in Vietnam the capture of sea turtles and marine mammals is rare and trawl fishermen normally released them alive back into the sea **(Nguyen, 2017)**

CONCLUSION

Trawl fishing trips were seen to be shorter in comparison to previous studies, while the gillnet fishing trips remained with the same duration. Fishing yield calculated per HP of trawlers was seven times higher than that of the gillnets though the rate of bycatch from trawlers was far higher than that of the gillnets. Recently, the economic efficiency of trawlers and gillnets have been improved. A large proportion of the total fishery products from both the gillnets and the trawlers are sold to traders/wholesalers and later transported onwards to the processing factories and sold to retailers in the local markets. The economic fish species from the two fishing activities showed typical caught species for the type of fishing gears. Inclement weather and lack of capital were the two main reported constraints for fishing livelihoods.

From the above problems mentioned, it is important to give more discussion to the management policies of the small-scale fisheries of trawl and gillnet. Management measures that focus on fishing rights and access control such as territorial use rights or limited entry must be innovative and utilized in order to reduce fishing ground competition. A call for the efficiency of fisheries policies and regulations on financial access, credit funds and subsidy is also urgent at the moment to resolve the assess to capital problem for small-scale trawl and gillnet households. Furthermore, policies on mitigating environmental impacts, climate change and natural resources need to be maintained and promoted in the long term, in order to regenerate natural resources and biodiversity.

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