

MINISTRY OF EDUCATION AND TRAINING
NHA TRANG UNIVERSITY

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**ENHANCING THE EFFICIENCY OF FISHING AND
PROTECTING THE COASTAL MARINE RESOURCES IN
QUANG NAM PROVINCE**

Major: Fishing

Major Code: 9620304

SUMMARY REPORT OF DOCTORAL THESIS

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This was completed in Nha Trang University

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KEY FINDINGS

Title: Enhancing the efficiency of fishing and protecting the coastal marine resources in Quang Nam province.

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PhD Student: Pham Viet Tich; **Period of time:** 2014 - 2018

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Content:

1. The thesis generally analyzed and evaluated domestic and foreign studies which closely relates to the topic. Based on this, it proposed research objectives and content.
2. The thesis investigated, surveyed and supplemented scientific data on the current status of fishing activities in Quang Nam coastal waters with 6 main groups of occupations: purse-seine, gill-net, trawler, hooks and lines, traps and others.
3. The Thesis investigated, surveyed and supplemented scientific data on the current status of aquatic resource protection activities in Quang Nam coastal waters.
4. The thesis analyzed and assessed the status of fishing activities efficiency and of aquatic resources protection in the Quang Nam coastal waters.
5. The thesis developed 4 solutions to improve the fishing activities efficiency and aquatic resources protection in coastal waters, including:
 - Reducing the number of banned fishing boats and fishing boats which operate in occupations that damage ing aquatic resources in Quang Nam coastal waters according to a specific anual schedule
 - Switching environmentally harmful or banned occupations to environmentally friendly occupations (traps, etc.).
 - Building artificial reefs to protect Quang Nam coastal resources.
 - Strengthening administrative management capacity and measures.

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INTRODUCTION

The coastal zone (CZ) of Quang Nam province, as determined by Decree 33/2010/ND-CP [11] and Decree 26/2019/NĐ-CP [14] has a total area of 1,936.6 km². There are many reasons for coastal resources degradation, but the main ones are over-exploitation, large fleet of coastal fishing boats (over 92%), and narrow fishing grounds,.... Besides, , the trawls work almost all year round with small mesh size and the non-selective fishing. This have destroyed the fisheries and resources, the ecological environment of coral reefs, grass beds - seaweed, leading to the loss of habitat, reproduction and development of aquatic species.

The exploitation intensity in Quang Nam's coastal zone has been beyond the permitted level; many types of occupations have negatively affected coastal marine resources such as trawl nets, rope-catching, with very small mesh sizes, catching young fish which are immature. In addition, this coastal zone is under considerable pressure from neighbouring provinces' fishing boats of which are mainly ≥ 20 CV trawlers and ships, still sweeping day and night [1,2].

From the above issues about the exploitation and protection of aquatic resources in Quang Nam coastal waters, the graduate student proposes that the PhD thesis **"Enhancing the efficiency of fishing and protecting the coastal marine resources in Quang Nam province"** is very essential and urgent for the province at this moment

CHAPTER 1: OVERVIEW

1.1. The overview of Quang Nam province

1.1.1. Geographical location, administrative unit

The North borders Thua Thien Hue province and Da Nang city, the South borders Quang Ngai province, the West borders Laos and Kon Tum province, the East borders the East Sea. The total natural area of Quang Nam province is 1,043 million ha, with 02 cities, 15 districts, and 01 town and 244 administrative units at commune level (213 communes, 18 wards, and 13 towns).

The coastline runs over 125km and the exclusive economic zone is larger than 40.000km², forming many fishing grounds with rich marine resources, which are favorable for the development of fishing profession. Besides, there are many estuaries and large creeks with nearly 30.000 ha of water surface (fresh, brackish and salty) [50]

1.1.4. Fishery potential

Seafood resources:

The total reserve of floating fish and bottom seafood is 712 thousand tons and the exploiting ability is 294 thousand tons. According to previous studies, marine resources in Quang Nam waters are diverse in types, but the number of each species is not abundant, so it is necessitated to arrange concurrent jobs per boat to improve production efficiency.

Crustaceans

The results of studies over the years on shrimp resources along the coast of Vietnam of Pham Ngoc Dang (1996) identified a number of important distribution and exploitation sites, including lobster breed resources in Cu Lao Cham.

Molluscs

Three species of molluscs with high economic value in Quang Nam are squid, cuttlefish and Purpleback Flying-Squid. Purpleback Flying-Squid is the species with the highest yield.

Aquatic plant and animal resources

5 algae branches with 126 species are identified. Silica is the most dominant, followed by the thyroid algae, blue algae, and eye algae, and a species of green algae.

1.1.5. Aquatic exploitation field

1.1.5.1. Changes in number and structure of fishing vessels

From 2014 to 2018, the total number of boats in the province increased slowly from 4,172 to 4,515; boat and ship structure in terms of capacity has changed, the group of over 90 cv ships increased rapidly at the rate of 14.8% / year. Especially, the group of over 400 cv remarkably increased at a rate of 61.6% / year, from 141 units in 2014 to 575 in 2019. Most capacity groups tend to increase in number, except for the group of capacity from 50-90cv which tends to decrease from 234 units in 2014 to 180 units in 2019 [9].

The group of vessels under 20 cv has not changed much, due to the impact of Decision 289 / QD-TTg in 2008 of the Prime Minister on fuel support for fishermen, which has prompted a large number of small ship owners to register for fishing activity, leading to a significant increase in the number of small **fishing vessels from 2008 to 2013 [50]**.

Table 1.1. Number of boats by power (CV) from 2014 to 2019

Year	Number of boats by power (CV)					Total
	<20	20÷<50	50÷< 90	90÷< 400	≥400	
2014	3.523	743	234	369	141	5.010
2015	3.560	758	243	421	187	5.169
2016	3.595	834	236	488	300	5.453
2017	3.656	821	223	500	425	5.625
2018	3.672	836	217	480	501	5.706
2019	3.661	852	180	313	575	5.581

Source: Quang Nam Department of Agriculture and Rural Development (2014-2019)

Table 1.2. Number of boats by local from 2014 to 2019

No.	Local (name)	2014	2015	2016	2017	2018	2019
1	TP Tam Kỳ	406	427	469	488	495	457
2	TP Hội An	1188	1254	1274	1309	1316	1314
3	Núi Thành	1.954	1.940	2.071	2.153	2.175	2.111
4	Duy Xuyên	451	481	529	540	573	585
5	Thăng Bình	773	811	827	848	853	826
6	Điện Bàn	238	256	283	287	294	288
Total		5.010	5.169	5.453	5.625	5.706	5.581

Source: Quang Nam Department of Agriculture and Rural Development (2014-2019)

1.1.5.2. Structure of fishing

The socio-economic structure is divided into 6 main groups of occupations, including trawl nets, grids, gill nets, fishing, fixed occupations and other occupation groups. In 2018, the proportion of the structure of the socio-economic occupations of the occupation groups is as follows: The tow net occupies 3,6% of the total number of ships, the net-net accounts for 8,4%, the gill net accounts for 44,3%, the fishing profession accounts for 20,6%, the fixed occupations account for 1,9%, the traps accounts for 5,9%, the other occupations (scooping, clawing, blinds, crabs traps, pens, bottom, diving, services ...) 14,3% [9].

1.1.5.3. The development of fishing output, fishing value

Catches has increased continuously over the years, reached 60,891 tons in 2014 and 78,167 tons in 2018, with a growth rate of 3.7% per year. Fishery production increased due to the rapid increase in the number of offshore fishing vessels and offshore production.

Table 1.5. The value of fishing output in the period 2014-2019

No.	Content	Measure	2014	2015	2016	2017	2018	2019
1	Amount	ton	60.891	63.480	79.935	85.266	91.402	92.164
2	Value	Billion VND	2.020	2.303	2.310	2.450	2.650	2.700

Source: Quang Nam Department of Agriculture and Rural Development 2019

1.1.6. The protection and development of aquatic resources

Annually, more than 30 patrols on river and sea areas were organised, detecting and handling dozens of administrative violations on the exploitation and protection of aquatic resources, with a fine of hundreds of millions VND. the State's regulations in the field of fishing and the marine protection was frequently propagandised directly to fishermen at mobile working places [9, 46, 48].

1.2. Overview of domestic and foreign scientific research

1.2.1. Overview of international research projects

Studies aimed at improving the efficiency of aquatic exploitation such as: Scientific work "Small-scale fisheries management: Institutional framework and approach for 3rd world countries - developing countries", the topic of "Managing fishing forces in small-scale fisheries" by Professor Robert Pomeroy [61] [62], the study "Managing fishing forces in China: in regards to theoretical and practical aspects

” [66] has focused on researching, proposing solutions, developing action plans to manage the fishing power, building an appropriate correlation between the fishing power and the maximum fishing capacity of each sea area to tackle overcapacity and prevent overexploitation. From that, aquatic resources will be restored, resulting in sustainable fishing activities, which is also a way to improve production efficiency.

Studies aimed at improving the efficiency of aquatic resource protection such as: The study "Overview of small-scale fisheries in Thailand Gulf" [65] has focused on researching, implementing and performing a series of management policies to restore resources and sustainably develop fisheries; The research work "Effects of natural and artificial reefs on aquatic species habitats" [60] has identified the need for habitat compensation for aquatic species to fulfill the task of restoring and regenerating the marine resources. The fastest way to compensate is to build a system of artificial reefs, scrubbing-artificial reefs, etc. The content of the studies focuses on the protection of aquatic resources by banning harmful occupations in coastal water (trawling, fishing, etc.) and, at the same time, constructing an artificial reef system that has expanded the habitat area for aquatic species, restored and regenerated resources as well as prevented fishing activities of prohibited craft. These are practical solutions that need to be applied to improve the effectiveness of aquatic resource protection in the coastal water.

All of the research works performing solutions to reduce the intensity in the coastal water showed that: To improve the efficiency of exploitation, it is necessary to reduce the fishing intensity in the sea area; To improve the effectiveness of the protection of aquatic resources, it is also essential to reduce the fishing intensity in that sea area. The studies showed that in order to reduce power, national governments (China, Taiwan) must use policies to re-purchase ships for fishermen, destroy ships, ... This current solution is not feasible for poor countries, including Vietnam. Additionally, the studies have not addressed the issue of solving livelihoods for fishermen when they have no ships to produce. Therefore, it is necessitated to study a solution to reduce the intensity in accordance with the practice of small-scale fisheries in the coastal water of Vietnam.

1.2.2. Overview of national research

1.2.2.1. Research works to improve the efficiency of fishing

The doctoral thesis of To Van Phuong in 2016 "Rational exploitation of aquatic resources in the coastal areas in Nui Thanh district, Quang Nam province" [37] carried out from 2013 to 2016. The author used the Schaefer model to calculate the intensity value and reasonable fishing output. Specifically, the exploitation productivity of occupations has decreased over time (Table 1.5); The actual exploited output is lower than the permitted capacity (Table 1.6)

The technical doctoral thesis of Nguyen Thi Hoa Hong in 2018 "Reasonable exploitation of aquatic resources in coastal areas from Cua Lo to Dien Chau, Nghe An province" [21] using Schaefer model to determine maximum sustainable capacity and yield for each fishing occupations. The results showed that the status of fishing activities in the area occurred unreasonableness in terms of fishing capacity and output of each profession as well as total intensity and output in the entire research area. The thesis determined the maximum sustainable fishing capacity and yield and the number of ships that need to be cut down for the studied waters.

1.2.2.2. Research on improving efficiency of aquatic resource protection of research zone

The Ph.D. thesis on " Reasonable fishing on coastal area in Nui Thanh district, Quang Nam province" [37] by To Van Phuong successfully defended in 2016 showed that boats operating on the coastal waters of Nui Thanh district with large numbers, especially the tendency to increase in both quantity and capacity, has caused the decline in resources. The thesis suggested artificial reef stocking as one of the preeminent models for regenerating, protecting and developing coastal resources in Nui Thanh district.

CHAPTER 2: METHODOLOGY

2.1. Theoretical basis

2.1.1. General theoretical basis

To perform the thesis, the PhD student inherited the general research method which is, by investigating and assessing the current status of exploitation and protection of aquatic resource, to analyze and figure out the shortcomings and limitations; inadequacies and unreasonable issues, etc, thereby proposing solutions to improve the efficiency of exploitation and protection of aquatic resources in the coastal waters of Quang Nam province. Research approaches include:

- Access to local resources on the management of aquatic resources conservation and exploitation
- Access to relevant domestic and foreign scientific research materials
- Approaching the reality of production through investigating the actual status of aquatic resources conservation and exploitation activities in Quang Nam province's coastal area.

2.1.2. Theoretical basis for estimating the total catch in the research area

Based on the guideline of FAO [58] (FAO (2002), Sample-based fisheries surveys: A technical handbook, FAO Fisheries Technical Paper 425, Rome, Italy.):

- Identify the average exploitation capacity of each occupation by the following formula:

$$\overline{CPUE}_i = \frac{1}{n} \sum_{j=1}^n CPUE_{ij}$$

- Determine the total exploitation output of each occupation by the formula:

$$C_i = \overline{CPUE}_i \cdot A_i \cdot BAC_i \cdot F_i$$

- The total catch of the whole sea area is determined by the formula:

$$C = \sum_{i=1}^n C_i$$

2.1.3. Some other specific issues:

Because the number of ships operating in the coastal area in Quang Nam province is enormous and complex; vessels of various sizes (<20CV or >20CV), including many different occupations, consisting of those that are prohibited and operate stealthily; including boats from outside the province (not allowed to operate in Quang Nam coastal area),..., it is not possible to survey the entire number of ships, in the conditions of the doctoral student. Therefore, the investigation must be carried out according to a certain number of samples, provided that this number of samples is representative and random for the population of the sample. To determine the sample size for the survey, the researcher used Yamane formula (1967 - 1986) [67], with the total number of ships of the coastal districts of Quang Nam province operating in the coastal area.

2.2. Content

2.2.1. Investigate the current status of fishing activities in the Quang Nam coastal waters

- The number of boats by fisheries, by locality, by capacity group; size and characteristics, ... working in the Quang Nam coastal waters.
- Fisheries and fishing gear, equipment for fishing in the research area;
- Number and characteristics of crew;
- Productivity, output, product composition of each profession in each year from 2015 to 2019.

2.2.2. Investigate the current status of aquatic resource protection activities in the Quang Nam coastal waters

- The current situation of the local government for the protection of aquatic resources
- Current status of local fisheries protection activities in the research area;
- The status of the fleet operating in the research area which damage the aquatic resources

2.2.3. Analysis and evaluation of the efficiency of fishing activities in the research area

- Analysis and evaluation to clarify the exploitation efficiency of each profession.
- At the same time, clarify the level of reduction in exploitation efficiency of each profession.

2.2.4. Analysis and evaluation of the effectiveness of aquatic resource protection activities in the research area

- Analyzing and clarifying the effectiveness of the local aquatic resources protection;
- At the same time, clarify the level of efficiency reduction of the aquatic resource protection activities in the research area.

2.2.5. Proposing solutions to improve the efficiency of exploitation and protection of aquatic resources in the research area

- Solutions to reduce the pressure of exploitation in the research area;
- Solutions to change occupations to reduce the damage on aquatic resources;
- Solutions to supplement the habitat of aquatic species;
- Solutions to improve the management capability of the local government.

2.3. Methods

2.3.1. Documentation and secondary data collection

Collect data at the Department of Agriculture and Rural Development, the Fisheries Sub-Department of Quang Nam, the Agricultural Extension Center of Quang Nam Province, the Border Guard posts, the Division of Agriculture and Rural Development of the districts, towns and cities in the Quang Nam province, including:

- Fisheries planning to 2020 and vision to 2030.
- Annual report on exploitation and protection of aquatic resources.
- List of local fishing boats each year.

- Minutes of inspection and examination of boats which engaged in illegal fishing activities in the research area.

- Status of production activities of fishing boats in Quang Nam province.

- Minutes and diary numbers of Border Guard stations in Quang Nam province.

2.3.2. Methods to investigate primary data

2.3.2.1. Methods to investigate the actual number of fishing vessels engaged in fishing activities in the research area

In order to accurately determine the actual number of vessels engaged in fishing activities in the Quang Nam coastal waters, the PhD student took five steps as follows:

Step 1: Make a list of fishing boats of districts and cities in Quang Nam province.

Step 2: Make a preliminary list of fishing vessels operating in the research waters.

Step 3: Identify fishing boats entering or leaving the study area

Step 4: Verify the reality of ships operating in the research waters

Step 5: Make a list of actual ships operating in the research waters

2.3.2.2. Determine the sample number and sample distribution

- Based on Yamane formula (1967 - 1986) [67] to calculate the sample size for the investigation:

$$n = \frac{N}{1 + N.e^2} \quad (2.1)$$

Of which: n - Number of samples to be investigated; N - Overall sample; e - Desired level of accuracy (choose e = 5%).

By a preliminary survey in 2016, there are 4311 fishing vessels operating in the Quang Nam Province's coastal zone, according to formula 2.1, the number of samples should be investigated is:

$$n = \frac{4311}{1 + 4311.0.05^2} = 366 \quad (2.2)$$

The subjects surveyed and interviewed were fishermen households, boat owners, and captains working in coastal fishing.

2.3.2.3. Information content and investigation methods

To collect data with high accuracy, the doctoral student cooperated with local fisheries management agencies to participate in surveying boats engaging in inshore fishing through the form of interviews with fishermen according to the designed questionnaire form. (Investigation Form No. 1, Appendix 1).

2.3.3. Method of determining the number of ships to be cut for solution no.1

The Ph.D. student used the maximum sustainable fishing output data investigated and evaluated by the Fisheries Research Institute in the coastal area of Quang Nam province and surrounding areas in 2016-2017 as the allowable catch output served as the basis for calculating the number of boats need to be cut. The number of ships which should be cut down is determined as follows:

- Ensuring the principle: after being reduced, the remaining ships should be enough to exploit the output that does not exceed the allowed one of interested area.
- Prioritize the reduction of boats in the following order:
 - + The number-one priority is the boats from outside the province;
 - + The second is to cut down on boats doing prohibited occupations, occupations harming the aquatic resource;
 - + The third is ships operating in the wrong area (vessels with capacity $\geq 20CV$).

2.3.4. Methods of processing survey data

2.3.4.1. Processing secondary data

- Research works on natural conditions, socio-economic conditions and fishery information of the studied localities are used to write the research overview.
- The conference reports, articles, research results are used to present the overview of scientific research related to the thesis topic.
- Lectures, textbooks, monographs are used to serve the theoretical basis and research methods of the thesis topic.

2.3.4.2. Primary data processing

Including rough processing of survey data and determination of the confidence interval of the mean according to the method of experimental arrangement and processing of experimental data, Nha Trang University - Nguyen Dinh Thuan (2008) [17]

The information and data are analyzed and processed using popular computer softwares (such as Microsoft Excel, SPSS).

2.3.5. Methods to evaluate mining efficiency

Carried out based on the fishing productivity of the fisheries; catches of fisheries; Comparative metrics (Return on Capital - DL1 (%) = LN/V (%); Return on Sales - DL2 (%) = LN/DT (%); Return on cost - DL3 (%) = LN/C (%); Based on crew income.

2.3.6. Methods to assess the current status of the effectiveness of the protection of aquatic resources

Evaluate the effectiveness of aquatic resource protection activities based on the following criteria: effectiveness in communication and education activities; inspection and supervision of fishing vessels' activities in coastal waters; the decline in aquatic resources in the coastal water; the status of exploited products in violation of current regulations more or less; actual status of violation of using prohibited fishing gear and incorrect mesh size; status of habitat decline of marine species in the coastal area.

2.3.7. Methods to develop solutions to improve economic efficiency and protect aquatic resources

Determined that the viewpoint and orientation to build a solution is to overcome the shortcomings and limitations, based on the actual situation of aquatic resource exploitation and protection in the interested area; consistent with the policy of the State from the central to the local; with the consensus of the fishermen, ensuring the life for the fisherman community, inheriting from the domestic and international research results.

The research result must have high feasibility, be able to replicate the model, and improve the efficiency of exploitation and protection of aquatic resource sustainably.

The proposed solutions include:

- Reduce the number of boats operating in the research area.
- Change prohibited occupations into environmentally friendly occupations.
- Preventing illegal trawling and increasing habitat for marine species.
- Enhance administrative measures in the research area.

The steps to build the solution include: 1) Developing the name and content of the solution; 2) Expert consultation and direction of authorities at all levels; 3) Survey of the fishing community; 4) Model building and model testing (if any); 5) Meeting with the fishing community to disseminate the model and test results (if any); 6) Meeting and guiding fishermen to voluntarily register to participate in the model (if any); 7) Develop a roadmap for solution implementation.

CHAPTER 3: RESULTS AND DISCUSSION

3.1. Investigation results of the actual status of the aquatic resources exploitation in the Quang Nam coastal zone

3.1.1. Current status of fishing boats in the coastal waters of Quang Nam

3.1.1.1. Changes in the number of fishing vessels in Quang Nam coastal zone

Quang Nam has 6 coastal districts, towns and cities engaged in fishing. The survey shows that not only boats from the aforementioned localities are fishing in the coastal areas of Quang Nam province, but boats from other provinces also regularly exploit at this area. this sea waterfall. Survey results of the actual number of fishing boats operating in the Quang Nam coastal zone by local units (districts, cities) and capacity groups (<20cv and 20 ÷ 49cv) are presented in Table 3.1.

Table 3.1: Changes in the number of fishing boats in coastal zone by locality and capacity

Name	Power group	2015	2016	2017	2018	2019
Nui Thanh	<20cv	1198	1250	1238	1216	1206
	20÷49cv	297	302	330	359	374
	<i>Total 1</i>	1495	1552	1568	1575	1580
Tam Ky	<20cv	341	350	354	360	368
	20÷ 49cv	27	25	29	26	22
	<i>Total 2</i>	368	375	383	386	390
Thang Binh	<20cv	575	576	577	580	582
	20÷ 49cv	55	58	60	58	61

Name	Power group	2015	2016	2017	2018	2019
	Total 3	630	634	637	638	643
Duy Xuyen	<20cv	286	296	319	319	321
	20÷ 49cv	130	129	130	134	138
	Total 4	416	425	449	453	459
Hoi An	<20cv	821	828	898	908	924
	20÷ 49cv	280	277	230	224	215
	Total 5	1101	1105	1128	1132	1139
Dien Ban	<20cv	199	218	236	238	241
	20÷ 49cv	22	24	16	14	13
	Total 6	221	242	252	252	254
Other	<20cv	292	247	191	172	175
	20÷ 49cv	91	135	186	175	128
	Total 7	383	382	377	347	303
Total (1÷7)	<20cv	3712	3765	3813	3793	3817
	20÷ 49cv	902	950	981	990	951
	Total	4614	4715	4794	4783	4768

Source: Appendix 3

3.1.3. Labor status on fishing vessels at Quang Nam coastal waters

Table 3.16: Educational attainment and working age

No.	age	Level				Total	
		Illiteracy	Primary	Secondary	High School	(number)	(%)
1	< 20	8	130	175	0	313	16,00
2	20 ÷ 39	21	485	431	61	998	51,02
3	40 ÷ 59	41	238	177	33	489	25,00
4	≥ 60	35	74	42	5	156	7,98
Total	(number)	105	927	825	99	1.956	100
	(%)	5,37	47,39	42,18	5,06	100	

Source: survey data

3.1.4. Survey results on the exploitation yield and productivity

The exploitation productivity of all occupations is expressed in a general unit as ton/vessel/year. Survey results of fishing productivity of occupations, from 2015 to 2019, are presented in table 3.3.

Table 3.19: Average productivity by ship, occupation and year

Unit of measure: ton/vessel/year

TT	Nghề	2015	2016	2017	2018	2019
1	Gill net	4,616	4,424	3,919	3,873	3,289
2	Hooks and lines	3,828	3,545	3,252	2,969	2,676

TT	Nghề	2015	2016	2017	2018	2019
3	Trawl	6,717	6,323	5,737	5,545	5,282
4	Pureseine	48,818	45,525	42,828	37,919	35,314
5	Trap	34,535	35,919	37,242	38,636	39,656
6	Others	6,535	6,213	5,121	4,636	4,121

Source: Appendix 3

Table 3.19 shows, in the period 2015-2019:

- The Pureseine and trap profession has higher productivity than the other jobs, especially fishing with the lowest productivity.

- The Pureseine job has the highest exploitation productivity (average value 42,081 tons/boat/year), the second is the trap profession (37,198 tons/boat/year). The remarkable point is that the productivity of these two occupations is reversing; The productivity of the Pureseine job is decreasing while the cage-trap profession tends to increase.

3.1.4.2. Fishery production in the Quang Nam coastal zone

The PhD student has investigated and synthesized the total exploitation output of each occupation in each year from 2015 to 2019 as shown in Table 3.20.

Table 3.20: Total exploitation output by occupation from 2015 to 2019

Unit: tons

No.	Fishing	2015	2016	2017	2018	2019
1	Gill net	9920	9693	8743	8757	7446
2	Hooks and lines	3020	2832	2615	2497	2221
3	Trawl	2499	2479	2323	2290	2419
4	Pureseine	6395	6647	6553	5840	5121
5	Trap	11086	11314	11843	11591	11302
6	Other	5568	5418	4522	3774	3239
Total		38.488	38.383	36.599	34.748	31.748

Source: survey data

3.1.5. Survey results on economic data of fishing vessels in Quang Nam coastal waters

3.1.5.1. Survey results of economic indicators of fishing vessels in Quang Nam coastal waters

Economic indicators of occupations operating in the Quang Nam coastal waters, including initial investment, revenue, production costs and profit. Survey results of

economic indicators for 366 fishing vessels operating in research area, are shown in Table 3.41.

Table 3.41: Economic index of ships engaged in the economic and economic development in Quang Nam coastal province

Fishing	Power (cv)	investment (Mil./vessel)	revenue (Mil./vessel)	production costs (Mil./vessel)	profit (Mil./vessel)
Gill net	<20	310	420	315	105
	20÷ <90	350	540	420	120
	Total	660	960	735	225
Hooks and lines	<20	290	300	208	92
	20÷ <90	320	360	250	110
	Total	610	660	458	202
Pureseine	<20	-	-	-	-
	20÷ <90	750	1200	882	318
	Total	750	1200	882	318
Trawl	<20	300	300	155	145
	20÷ <90	370	432	250	182
	Total	670	732	405	327
Trap	<20	270	312	178	134
	20÷ <90	290	360	214	146
	Total	560	672	392	280
Other	<20	250	336	205	131
	20÷ <90	280	408	255	153
	Total	530	744	460	284

Source: survey data

3.1.5.2. Average income of seafarers by occupation and capacity

By investigating and processing data and based on the actual situation, the PhD student has brought about the average income of workers per ship in a month and agreed on a unit of calculation (million VND / person / month). Survey results on average income per worker for each occupation are presented in Table 3.42.

Table 3.42: Average income of seafarers by occupation and capacity

No.	Fishing	Power group	Average crew (people/boat)	Average income (Mil.VND/individual/month)
1	Gill net	<20cv	3	5,503
		20 ÷ 49cv	5	7,512
2	Hooks and lines	<20cv	3	6,027
		20 ÷ 49cv	5	7,740

No.	Fishing	Power group	Average crew (people/boat)	Average income (Mil.VND/individual/month)
3	Pureseine	<20cv	-	-
		20 ÷ 49cv	6	8,567
4	Trawl	<20cv	3	6,500
		20 ÷ 49cv	5	8,502
5	Trap	<20cv	2	6,525
		20 ÷ 49cv	4	7,802
6	Other	<20cv	2	5,515
		20 ÷ 49cv	4	7,505

Source: survey data

3.2. Results of the investigation on the status of the marine resources protection in Quang Nam coastal zone

3.2.2. Current status of local aquatic resources protection

Table 3.45: Summary of inspection, examination and violation handling

Year	Number of inspections (times)	Number of cases of handling violations (times)	Amount of administrative fines (1.000VND)
2015	32	34	156.550
2016	31	41	51.300
2017	24	37	85.200
2018	29	39	123.450
2019	29	51	210.800

Source: Quang Nam Fisheries Sub-Department

Table 3.45 shows that, the specialized inspection force of the Fisheries Department regularly inspects and supervises fishing activities in natural water areas of the province in combination with propaganda and dissemination of regulations. legislation on the protection of aquatic resources.

3.4. Proposing solutions to improve economic efficiency and fisheries conservation at research area

3.4.1. Reducing the number of fishing boats in Quang Nam coastal zone

3.4.1.3. Content

Content 1: Firmly and specifically manage shipowners, ship's registration number, residence address

Each residential group (village, hamlet), ward (commune), district (city, town) reviews the list of shipowners operating in the wrong regions, prohibited trades and send a list to the Fisheries Department.

Content 2: To do education, propaganda and mobilize fishermen

Propaganda fishermen to understand clearly the provisions of the legal documents on fisheries, understand the harms of infringements on marine resources. The forms are local radio and television; organize the distribution of documents, leaflets; organize training classes; ...

Content 3: Develop a roadmap for reduction implementation

Firstly, bring the group of ships from other provinces and ships using banned fishing gears (trawl nets, rope) out of research area. Next is the group of ships with $L \geq 12m$ and the group of ships with a capacity of 20cv or more. The roadmap for reducing the number of violating ships in the research area is summarized in Table 3.73.

Table 3.73: Roadmap to reduce the number of boats violating researched zone

Fishing	Sum (boats)	2020		2021		2022	
		Boats	Kind of boats	Boats	Kind of boats	Boats	Kind of boats
Gill net	286	100	$L \geq 12m$	86	$L \geq 12m$	100	$\geq 20cv$
Hooks and lines	243	80		63	$L \geq 12m$	100	$\geq 20cv$
Trawl	458	303	Other province	100	$L \geq 12m$	55	$< 20cv$
Pureseine	145			100	$L \geq 12m$	45	$\geq 20cv$
Trap	63	21	Trap	20	$L \geq 12m$	22	$\geq 20cv$
Other	25	25	$L \geq 12m$				
Total	1220	529		369		322	

Content 4: Implementation

- During training courses, it is necessary to help fishermen and boat owners understand which ships and occupations are harmful to marine resources and need to be cut down; jobs that are environmentally friendly are allowed to operate; Which jobs are exploited with high efficiency for everyone to choose. The solution for those ships that have to cut down is to change jobs; or moving to open areas or high areas of activity; or transfer to their own local waters (if the ship is another province).

- For shipowners in Quang Nam province with a capacity of $\geq 20\text{cv}$ or $L \geq 12\text{m}$, they must write a written commitment not to put the ship into operation of the coastal zone (bringing the ship to open areas of operation, or registering to upgrade the ship to operate in the offshore area).

- For fishing trawl and rope fishing with a capacity of less than 20cv or $L < 12\text{m}$ (operated in the coastal zone), the ship owner registers to change the cage-trap profession (crab, squid, ...)

Content 4: Implementation

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- For fishing trawl and rope fishing with a capacity of less than 20cv or $L < 12\text{m}$ (operated in the coastal zone), the ship owner registers to change the job of trapping (crab, squid, ...), to change to occupation other (tourism services, marine farming services,...).

- For ships in your province: In 2019, there are 303 trawlers of the provinces you operate in the Quang Nam coastal zone, then notify the local authorities, the provincial fisheries department of your province to take measures to coordinate and prevent this ship.

- Measures: the fisheries protection agency, the border guards have strict inspection measures to promptly stop them.

3.4.1.5. Results of implementing the solution

Thanks to the propaganda and advocacy of the Fisheries Branch and the participation of the government system, the unions (including the Buddhist Church),

many fishermen have raised awareness, voluntarily registered not to violate the claim. waterfall. Specifically as shown in Table 3.75.

Table 3.75: Actual registration of fishermen to reduce the number of boats over the years

No.	Fishing boat	Total (boats)	Change of occupation			Roaming of operations		
			2020	2021	2022	2020	2021	2022
1	Trap	63	10	6	5	-	20	22
2	Trawl	155	25	25	23	20	40	22
3	Purseine	145	-	-	-	45	50	50
4	Gill net	286	-	-	-	100	100	86
5	Hooks and lines	243	-	-	-	80	100	63
6	Other	25	-	-	-	5	10	10
Total		917	35	31	28	250	320	253

(Note: only registered to change jobs of 155 trawl in Quang Nam, while 303 ships from other provinces moved to the local waters for operation).

3.4.2. Solution for changing to crab farming

3.4.2.3. Implement solutions to change cage and trap jobs

The selection of households to build the model of job change is done based on predetermined criteria and in order of priority as follows:

- Currently the ship owner is in the category of reduction (trawling, rope with capacity below 20cv);
- Fishermen households voluntarily change their current jobs.
- Commitment to participate in implementing the model under the guidance of the research team.
- Meet the abilities / competencies of the profession that need to be changed.
- Belongs to poor, near poor, ... need support to change careers.
- Having a good capacity and qualifications to receive technical procedures, guide the exploitation and preservation of good post-harvest products.
- Possess a professional qualification in fishing (boat and engineer certificate)
- The head of household strictly abides by the policies of the State and the locality where they reside.

The type of trap cage used for testing and transfer is as follows:

- + Cage diameter 540mm, height 200m, steel frame $\varnothing 8$, around the net green.

- + Mesh size of test cage of trap cage $2a = 4\text{cm}$
- + Size in grid cuttings $2a = 2\text{cm}$ so that crabs get in do not get entangled
- + There are 2 types: 3-door type and 1-door type (cuttings)
- + Number of 1-door circular cylindrical cages: 1,000 units
- + Number of 3-door circular cylindrical cages: 500 pieces

3.4.2.4. Results of the model of changing to crab cage

3.4.2.5. Discuss the effectiveness and feasibility of the solution

In order to evaluate the economic efficiency of the traps, the thesis evaluates on two basic factors including investment costs (buy traps) and profits per trips.

a. Investment costs (buy traps)

The investment capital of traps is not high compared to other fisheries (equivalent to 1/10 of the investment capital compared to seine, gill nets), the manufacturing materials are easy to find, everyone can do it.

b. The revenue of the traps

Based on the results in Appendix 7 and Table 3.78, it shows that the revenue of the 4 fishing day with 25kg of crabs, the revenue from selling products is from 8.5 million VND to 9.5 million VND/trip 4 fishing days is pretty high.

c. Production cost

Based on the results in Appendix 7 and Table 3.78, it shows that the cost of the trial trip is about 2,000,000 VND/4 fishing day, which is low, suitable for the financial ability of coastal fishermen.

d. Economic profit and income of sailors

Based on the results in Appendix 7 and Table 3.78, it shows that the profit of the model ship is $6,500,000 \div 7,500,000$ VND/trip for 4 fishing days, with a 50/50 split, the owner earns from $3,300,000 \div 3,800,000$ VND/trip for 4 fishing days, the crew income is 414,000 VND/day - 475,000 VND/day, monthly is about 10 million - 12 million VND/month/person which is high.

3.4.3. Solution of artificial reefs to improve the efficiency of resource protection and development

3.4.3.4. Establishment of reefs to protect aquatic resources

Table 3.83: Coordinates of the study area limitation points

No.	Point (longitude, latitude)		No.	Point (longitude, latitude)	
Đ1	108040'30" E	15 ⁰ 31'10" N	Đ3	108041'30" E	15 ⁰ 31'35" N
Đ2	108041'30" E	15 ⁰ 31'10" N	Đ4	108040'30" E	15 ⁰ 31'35" N

- The area of the artificial reef to be arranged is 910,000m² (1,400m * 650m) in the approved area of 1,424,500m². Independent reefs are arranged around artificial reefs, 50m apart to create a belt for the site and the distance between blocks is 50m.

- The artificial reef area is arranged in 15 clusters, each cluster will arrange 28 reef blocks on the bottom floor with an area of 5,000m² (100m * 50m). The reef clusters are 200m apart in the direction East - West and North - South.

- Work continues until completion of 01 cluster with 28 reef units.

- After completing each cluster (28 reef units), use tugboat to move the barge to a new location and continue to carry out the above works.

3.4.3.7. Evaluate the effectiveness of the marine resources protection model

a) Survey animal resources before building marine resources protection model

Survey time is from April 10 to April 13, 2017, this is the time when sea water has a large degree of transparency to help make an accurate assessment.

Use 3 divers with expertise and experience in diving area resources. One diver goes first, observing and recording fast-swimming animals (fish, shrimp, squid ...), the following diver records slow-moving animals (snails, urchin, ...) and divers end up filming, recording the process and the subjects surveyed. The survey dive time per section was from 70 □ 90 minutes.

In addition to the objects directly identified during the survey, the research team also took pictures and videos to compare and identify species that were not identified during the diving.

The evaluation criteria include:

- Species diversity or number of species encountered in cross sections.
- Density of large organisms in the investigation area.

b) Survey after building the model to protect marine resources with artificial reefs

Every 3 months, to carry out 2 surveys, each 4 days, each day survey 8 cross sections in the middle of the artificial reef, as follows:

Stage 1: 4-day survey, from April 26, 2018 to April 29, 2018.

Stage 2: 4 days survey, from July 30, 2018 to August 2, 2018.

Objects of the survey are fish, crustaceans, molluscs and crustaceans that are large enough to be observed by the recessive method.

For small organisms, eggs and fry cannot be seen with the naked eye, so no assessment is performed.

To evaluate the effectiveness of the marine resources protection model, the study uses the survey dive method according to the cross section.

Divers perform cross-section parallel to the seabed to determine species composition and benthic density in and out of artificial reefs.

Every day, 2 clusters were surveyed, each cluster of reefs had to dive in 4 perpendicular sections in clusters of artificial reefs, 5 m wide and 20 meters long each. At the location of the reef clusters with high marine resources density, the work was only evaluated at the survey sections 5 meters away from the reef cluster.

Survey dive time per section is from 30 - 40 minutes

Surveyed at cross sections at locations 50m, 100m and 200m from the reef cluster. The external cross-section scale has an area of 100m² (5 m x 20 m). Survey dive time per section is from 30 - 40 minutes.

The assessment is based on the number of common species and their densities recorded at the surveys.

Table 3.84: Frequency encountered during the survey

No.	Frequency (times)	Number of species	Ratio (%)	Remarks
1	1 times	29	65,9	Max
2	2 ÷ 5 times	7	15,9	
3	> 5 times	8	18,2	
Total		44	100,0	

The survey has recorded the species encountered, these species are divided into 3 main groups, including: fish group, echinoderm group and mollusk group. The density of each group is shown in Table 3.85.

Table 3.85: Average density encountered (individual/200m²) at survey sections

Target group	MC 1	Ratio (%)	MC 2	Ratio (%)	MC 3	Ratio (%)	MC 4	Ratio (%)	Total	Ratio (%)
Fish	89	69,5	78	63,4	65	58,6	71	64,5	303	64,2
Barbed skin group	18	14,1	23	18,7	19	17,1	21	19,1	81	17,2
Molluscs	21	16,4	22	17,9	27	24,3	18	16,4	88	18,6

Total	128	100,0	123	100	111	100	110	100	472	100
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Survey results show that: The density of fish and other animals in the cross sections ranged from 110 to 128 individuals/200m², the average total reached 472 individuals/800m².

The fish species in the surveyed waters have relatively small individual sizes, rarely encountered large species or objects.

3.4.4. Enhancing the administration management

3.4.4.3. Content

Content 1: Supplementing facilities and forces capable of performing tasks

Content 2: Propagating and disseminating the law on fisheries to fishermen

Content 3: Carrying out inspection and supervision at sea

Content 4: Regular inspection and supervision at shores, fishing wharfs, residential areas

CONCLUSION AND RECOMMENDATION

I. Conclusion

1. Current situation in the period 2015 ÷ 2019, in Quang Nam province's coastal zone, there are 4614 ÷ 4768 fishing vessels actually operating in fishing, with more than 10 occupations divided into 6 main occupation groups: gill nets, trawls, fishing, fin nets, snare cages and other occupations (blinds, hops, scuba diving, ...). In which, gill net is mainly, accounting for 46.47 ÷ 47.48%; other occupations account for 16.48 ÷ 18.49%; fishing (16.77 ÷ 17.58%); the remaining occupations are less than 10%. Vessels operating in researched waters are mainly motorized ships with a capacity of less than 20CV, accounting for 79.30 ÷ 80.45%, most of them are small in size, shell materials are made of bamboo or wood with old and poor quality engines, rudimentary and inadequate safety and emergency equipment according to regulations.

2. The thesis has assessed that the current situation of fishing activities in research area is not highly effective because the productivity and catch output of most occupations decrease over time (except for cage and trap profession which always increases). The thesis also shows that, due to the small size of ships, old machinery and low investment capital, most occupations have high economic efficiency (return on capital is higher than the interest rate on bank deposits (> 31%/year)); The per

capita income (1,196÷1,560 million VND/person/month) of seafarers' households are higher than the poverty and near-poor lines in the period 2016÷2020.

3. The thesis has assessed the current situation of the local fisheries protection and protection in the period of 2016 - 2019, which has done well in propaganda to raise awareness of people in implementing the fisheries law. However, it also points out a number of limitations in this field, which is the resources at research area are showing signs of decline due to the large number of ships violating the area of operation and prohibited trades (914 ships in 2019); the rate of exploited products violating the prescribed size is very high; most professions violate mesh size; the area where aquatic species live is reduced.

4. Facing this situation, the thesis proposes 4 groups of solutions to improve the efficiency of the exploitation and protection of coastal area in Quang Nam province's textbook as follows:

(1) Solution to reduce the number of boats. Accordingly, 1220 fishing boats were cut, of which 823 ships had to move to open areas of operation because of engine capacity $\geq 20cv$ (or $L \geq 12m$) and 303 ships of your province had to bring ships to local waters. ; the 94 ships with a capacity of less than 20cv, which are currently in the forbidden profession, will be transferred to a resource and environment friendly profession.

(2) Solutions to change jobs for fishermen towards sustainability. The thesis has successfully tested the model of converting the rope-catching job to a highly effective job in crab cage, directly transferred to 2 fishermen households in 2019. It also Formulates a plan and process for implementing career change solutions.

(3) Solutions to protect and develop aquatic resources. The thesis successfully implemented the model of artificial reefs in Ban Than cape waters with an area of 1,424,500m² and installed 500 blocks of reefs. Accordingly, to limit illegal trawling vessels in order to protect and develop NTFPs; supplement the area of residence, reproduction and growth of marine species, contributing to the development of aquaculture.

(4) Solutions to strengthen facilities and forces for local fisheries protection. To add ships, ships and personnel capable of inspecting, controlling and handling and promptly preventing fishing vessels violating researched zone.

II. Recommendations

1. In addition to the central support policies such as Programs 67, 48,... Quang Nam province needs to review, develop and implement appropriate mechanisms and policies to support the development of sustainable fisheries. with the practical conditions of the province's fisheries, including policies to support the conversion of prohibited and invasive fishing occupations into environmentally-friendly, resource-efficient, and economically efficient occupations such as cage fishing, floating on the surface, capturing squid, fishing for tuna... or switching to aquaculture, serving tourism.

2. Based on the research results of the thesis, Quang Nam province needs to direct the development of a project to reduce coastal ships and issue a decision on implementation according to the proposed route. At the same time, directing the development of an investment project to develop artificial reefs for coastal waters and Cu Lao Cham Marine Protected Area in order to regenerate, restore and protect aquatic resources, and create sustainable livelihoods for the community. coastal fishermen.

3. To further strengthen the enforcement of the law on aquaculture protection and exploitation; propaganda, training, patrol, control and strictly handle violations of exploitation by prohibited occupations, wrong areas, wrong routes; strengthen administrative measures, effectively apply measures to ban new construction of small-capacity ships...

4. Organize work with Quang Ngai province and Da Nang city to coordinate to prevent fishing vessels of these two localities from encroaching on the coastal waters of Quang Nam.

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