WESTERN AND CENTRAL PACIFIC FISHERIES COMMISSION (WCPFC)

DEPARTMENT OF CAPTURE FISHERIES AND FISHERIES RESOURCES PROTECTION (DECAFIREP)

VIETNAMESE TUNA FISHERIES PROFILE
(Binh Dinh, Phu Yen and Khanh Hoa)

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Executive Summary

Vietnamese tuna fisheries have developed rapidly in recent years. The tuna export value raised over ten times from 22.98 million US$ in 2000 to approximately 379.4 million US$, accounted for about 6.9% of the total estimated delivered value of the WCPO tuna catch in 2011. Main fishing gears for tuna fisheries in Vietnam are longline, purse seine, and gillnet. The longline tuna fishery appears only in the three central provinces of Vietnam (Khanh Hoa, Binh Dinh, and Phu Yen) and its main targeted species are bigeye and yellowfin tuna. The gillnet and purse seine fisheries appear in almost all central coastal provinces and their catches are mainly skipjack tuna.

In 2011, total catch of fisheries in Binh Dinh province was estimated about 152,109 MT, contributed about 8.6 % of Binh Dinh's GDP. Tuna fisheries have recently played an important role in Binh Dinh province. In 2011, the total tuna catch was 38,887 metric tons accounted for about 26% of the total marine catch in Binh Dinh province, in which the yellowfin and bigeye tuna accounted for about 12%. Since the end of 2011, tuna handlines using lights have been developed from tuna longliners and become popular in Binh Dinh due to high production and longer fishing season. There are currently (2012) 1060 tuna handline boats and 786 tuna purse seine boats in Binh Dinh province.

Longline, purse seine and gillnet are main fishing gears for tuna fisheries in Phu Yen province. In 2011, there were 831 tuna boats, in which longline boats accounted for about 67 %, tuna purse seine accounted for 15.5% and gillnet accounted for 17.4% of the total number of tuna boats. Tuna longline boats are mainly registered in Tuy Hoa city and Tuy An district and its main products are yellowfin tuna and bigeye tuna. Total landing of these two species in Phu Yen was 4,986 metric tons in 2010 and 5684 metric tons in 2011.

In 2011, there were 8,941 fishing boats with about 30,000 fishers in Khanh Hoa province, in which, there were 352 tuna fishing boats, accounted for 3.9%. Longline, gillnet and pure seine are three main fishing gears for tuna fisherie in Khanh Hoa. In 2011, there were 99 tuna longline boats, 227 tuna gillnet boats and 26 tuna purse seine boats in Khanh Hoa province. Tuna longline and tuna gillnet boats are mainly in Nha Trang city. Tuna purse seine boats do not often operate in Khanh Hoa's sea waters. Some of the tuna purse seine boats have switched to purse seine with lights catching for small pelagic fishes. In 2011, the total tuna production for yellowfin and bigeye tuna (by longline) was about 1,950 mt, and total skipjack tuna production was about 11,000 mt (by purse seine and gillnet) in 2011.

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Acknowledgements

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Acronyms

UNCLOS – United Nation Convention on the Law of the Sea
WCPO - Western and Central Pacific Ocean
GSO - General Statistics Office of Vietnam
DECAFIREP - Department of Capture Fisheries and Resources Protection
RIMF - Research Institute of Marine Fisheries
VASEP - Vietnam Association of Seafood Exporters & Producers
NAFIQAD – National
CPUE – Catch per unit of effort
MCS - Monitoring, Control and Surveillance
EEZ – Exclusive Economic Zone
MT - Metric ton
HP – Horse power
YF – Yellowfin tuna
BY – Bigeye tuna
SKJ – Skipjack tuna

Chapter 1. An overview

1. Introduction

Vietnam's sea area is situated in the Western and Central Pacific Ocean (WCPO), the region where tuna resources are quite abundant. The total tuna catch in the region was estimated at 2,244,776 metric tons, accounted for 79% of the Pacific Ocean tuna catch and 55% of the global tuna catch in 2011 (Williams and Terawasi, 2011). The 2011 total catch of the region included four species: skipjack tuna (*Katsuwonus pelamis*) accounted for 69%, yellowfin tuna (*Thunus albacares*) accounted for 19%, bigeye tuna (*T. obesus*) accounted for 7% and albacore tuna (*T. alalunga*) accounted for 5% (Williams and Terawasi, 2011). In terms of production, Vietnamese tuna fisheries still play a moderate role in the WCPO region. In 2011, three main tuna species in Vietnam's sea area: skipjack tuna, yellowfin tuna and bigeye tuna accounted for about 2%, 3.6% and 3.1% of the total catches of these species in the WCPO region respectively (Williams and Terawasi, 2011; DECAFIREP, 2012). However, the fishing sector in Vietnam has been increasing its influence on offshore areas and focusing on high economic valued species. Tuna species, accounted for about 65% total stock biomass of pelagic fishes, is the most valuable comercial species in Vietnam's offshore areas (Son, 2005). Therefore, Vietnamese tuna fisheries have developed rapidly in recent years. The tuna export value raised over ten times from 22.98 million US$ in 2000 to approximately 379.4 million US$, accounted for about 6.9% of the total estimated delivered value of the WCPO tuna catch in 2011 (Williams and Terawasi, 2011; VASEP, 2012). Main fishing gears for tuna fisheries in Vietnam are longline, purse seine, and gillnet (DECAFIREP, 2012). The longline tuna fishery appears only in the three central provinces of Vietnam (Khanh Hoa, Binh Dinh, and Phu Yen) and its main targeted species are bigeye and yellowfin tuna. The gillnet and purse seine fisheries appear in almost all central coastal provinces and their catches are mainly skipjack tuna (DECAFIREP, 2012).

This report provides a broad description of tuna fisheries in Vietnam. It especially focuses on tuna fisheries in three central provinces of Vietnam, where the majority catches of yellowfin, bigeye and skipjack tuna have been harvested. The report gives basic information for those who are interested in Vietnamese tuna fisheries. It also provides necessary information for managers, fishers and other stakeholders.

This report will be constructed as follows: chapter 1 gives an overview of tuna fisheries in Vietnam and tuna fisheries environment overlapping in the three central provinces of Vietnam. The next three chapters present a detail description of tuna fisheries profiles of the three central provinces. The last chapter summaries some of the main conclusions and recommendations from the report.

2. Background information

Vietnam is located in Southeastern Asia, bordering the Gulf of Thailand, Gulf of Tonkin, and South China Sea alongside China, Laos, and Cambodia. Vietnam's coastline extends for some 3,444 kilometers in length and occupies a land area of 331,210 square kilometers (CIA, 2012). Fisheries sector represents an important source of economic growth, employment, nutrition, and foreign exchange in Vietnam (McCoy *et al.*,, 2010). Over six percent of export earnings stem from fisheries products, worth US$ 6.1 billion in 2011 (GSO, 2012). Out of 2030 identified marine fish species, Vietnam's sea area contains approximately 130 commercial viable species with a total official fisheries catch in 2011 of 2.3 million metric tons (GSO, 2012).

There are four main fishing areas in Vietnam: the Gulf of Tonkin, shared with China; the Central area of Vietnam; the South-eastern area of Vietnam; and the South-western area of Vietnam (part of the Gulf of Thailand), shared with Cambodia and Thailand. Apart from these geographical areas, according to the government's Decree No. 31/2010/NĐ-CP dated March 30th 2010 and the Decree No. 53/2012/NĐ-CP dated June 20th 2012 on amending and supplementing some articles of Decree 33/2010/ND-CP, the fishing zones can be further divided into inshore zone, coastal zone and offshore zone. The inshore zone is considered the waters from the baselines up to a limit not exceeding 6 nautical miles (within the territorial sea, according to UNCLOS 1982). The coastal zone covers the waters beyond the inshore zone up to a limit not exceeding 24 nautical miles (within the territorial sea and the contiguous zone, according to UNCLOS 1982). The offshore zone covers the waters beyond the coastal zone (Figure 1).

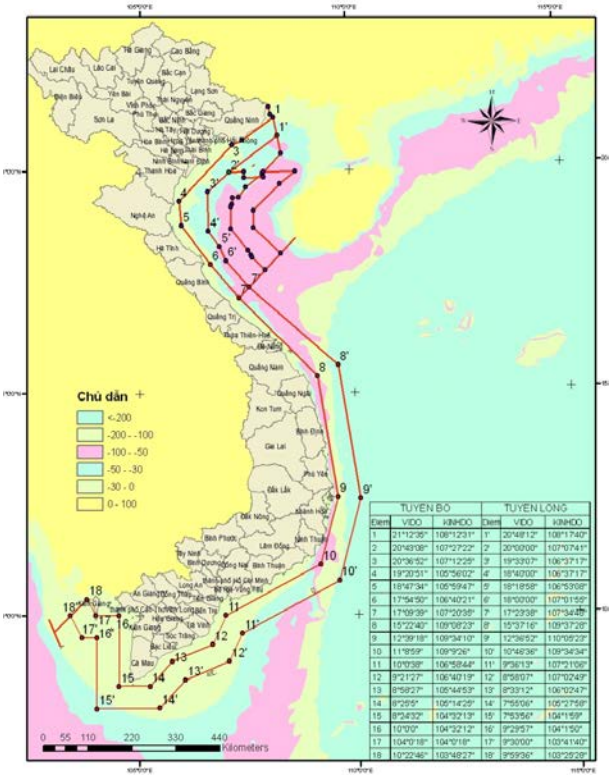

Figure 1. Vietnamese fishing zones according to the government's Decree No. 31/2010/NĐ-CP dated March 30th 2010

Vietnamese marine fisheries are regulated according to the size of the boat engine and the location of fishing activity (Decree 33/2010/ND-CP, Article 5). Specifically, boats (i) without an engine or with engines less than 20hp should operate the inshore zone, (ii) with engines between 20–90hp should operate in coastal zone and (iii) with engines over 90hp should operate in the offshore zone. Moreover, boat operators should obtain marine fishing licenses depending on their operation zones, the size of the boat engine, the gear type employed as well as other conditions. The fee levied is proportional to the engine size of the boat. Boats under 0.5 Gross Register Tonnage (GRT) are exempt from any license payment. The procedure for license applications is widely considered to be relatively straightforward, and a license application generally leads to a license being granted. In this case, Vietnamese marine capture fisheries can be viewed to be in 'open access' situation (McCoy et al., 2010).

3. Tuna fisheries in Vietnam

3.1 Tuna resources

In Vietnam' sea waters, tuna species mainly distribute in the central and southeast areas and can be categoried by two groups namely large oceanic tunas (yellowfin tuna, bigeye tuna, skipjack) and small mostly coastal tunas (frigate tuna, longtail tuna, bullet tuna, kawakawa, oreintal bonito). Tuna species are the main pelagic species, accounted for about 65% total stock biomass of pelagic fishes in Vietnam (Son, 2005). In group of scombrids, skipjack has largest stock biomass, accounts for about 82% of the total stock biomass of tunas. Followings are bullet tuna and frigate tuna which acount for about 8.4% of the total stock biomass. Yellowfin, bigeye tunas account for about 6% and other species account for 3.7% of the total stock biomas (Son, 2005). Biology of major tuna species in Vietnam are described as follows:

3.1.1 Yellowfin tuna (Vietnamese name: Ngừ vây vàng)

The taxonomy of Yellowfin tuna:

Class: *Actinopterygii*
Order: *Perciformes*
Family: *Scombridae*
Genus: *Thunnus*
Species: *albacares*

***Thunnus albacares* (Bonnaterre, 1788)**

According to FishBase[1], yellowfin tuna range throughout the world's tropical oceans, especially the tropical and sub-tropical waters of the Pacific Ocean, defined by the coordinates 52°N to 45°S, 180°E to 180°W. The habitat of yellowfin tuna is the open ocean, living above and below the thermocline, at temperatures of 15 to 31°C. It is generally found in the upper 100m of the water column (Gardieff, 2012a). Yellowfin tuna spawn over broad regions throughout the warmest waters of the equatorial Pacific, Atlantic, and Indian Oceans (Gardieff, 2012a). In Vietnam, Yellowfin tuna mostly distributes in the Central and Eastern seawater of Vietnam and lives in the big schools in the marine surface (Son, 2005).

3.1.2 Bigeye tuna (Vietnamese name: Ngừ mắt to)

The taxonomy of Bigeye tuna

Class: *Actinopterygii*
Order: *Perciformes*
Family: *Scombridae*
Genus: *Thunnus*
Species: *Obesus*

***Thunnus obesus* (Lowe, 1839)**

According to FishBase[2], bigeye tuna is highly migratory species found in tropical and sub tropical oceans. Bigeye tuna appears in areas where the depth range from 0-250m and water temperatures range from 13 to 29°C, but the optimum is between 17 and 22^{0}C. It feeds on a wide variety of fishes,

[1] http://www.fishbase.org/summary/Thunnus-albacares.html
[2] http://www.fishbase.org/summary/Thunnus-obesus.html

cephalopods and crustaceans during the day and at night. In Vietnam, Bigeye tuna mainly found in offshore waters of Binh Dinh, Phu Yen and Khanh Hoa provinces. The fishing season starts from November to July, in which of total catch in summer, from April to July, is higher than in winter, from November to March (Toan, 2011).

3.1.1 Skipjack tuna (Vietnamese name: Ngừ vằn)

The taxonomy of Skipjack tuna

Class: *Actinopterygii*
Order: *Perciformes*
Family: *Scombridae*
Genus: *Katsuwonus*
Species: *Pelamis*

***Katsuwonus pelamis* (Linnaeus, 1758)**

According to Fishbase[3] and Gardieff (2012b), the skipjack tuna is an epipelagic fish, occurring in tropical and warm-temperate waters with surface temperatures of 15 to 30°C. During the day, skipjacks remain at the surface, but they may descend to depths of 260 m at night. Skipjacks have a tendency to school, often under drifting objects or marine mammals. Skipjacks exhibit many types of schooling behavior, sometimes schooling with drifting objects, sharks, or whales. They may swim slowly in circular paths or travel in a single direction. These schools may consist only of skipjack, or other tuna species may be present. Skipjack often divide into schools based upon their size. In Vietnam, skipjack tuna highly distributes in offshore waters of the Central and Southeastern provinces such as Phu Yen, Khanh Hoa to Binh Thuan and Vung Tau province (Son, 2005).

3.2 Tuna fleet

In 2011, there were 2521 tuna fishing boats with engines of higher 50 HP in Vietnam (DECAFIREP, 2012). Tuna fishing gears are mainly longline, gillnet and purse seine. Figure 2 shows tuna fleet structure in Vietnam in 2011. Gillnet boats were dominant, accouted for about 52 percent of the tuna fleet, while longline and purse boats accounted for about 28 percent and 20 percent of the tuna fleet respectively. Due to differences in fishing selection leads to differences in catch compositions by the gear types. Main tareget species of tuna longline fishery are oceanic tunas including yellowfin tuna and bigeye tuna. Main species caught by purseine are skipjact, longtail kawakawa, frigate and bullet tuna while main catch in gillnet is skipjact tuna.

[3] http://www.fishbase.org/summary/Katsuwonus-pelamis.html

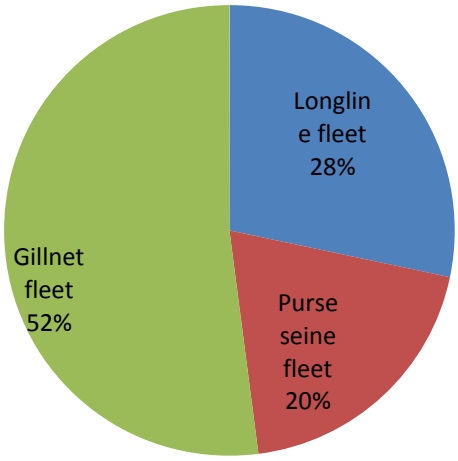

Figure 2. Tuna fleet structure in Vietnam in 2011
(DECAFIREP, 2012)

3.3 Tuna catch

Figure 3 shows the total tuna catch and tuna export volume from 2000 to 2011. The total tuna catch was stable at about 30 to 50 thousand metric tons in this period, but the export volume increased sharply from about 6 thousand metric tons in 2000 to over 80 thousand metric tons in 2011. The export volume has exeeded domostic tuna catch since 2007.

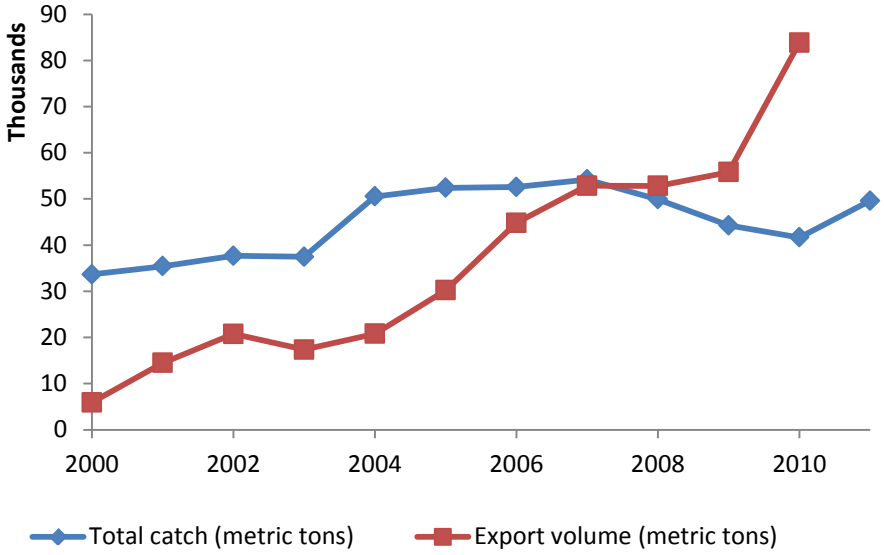

Figure 3. Tuna catch and tuna export volume in Vietnam from 2000 to 2011
(VASEP, 2012; WPEA-OFM, 2012)

The tuna catches from different fishing gears are shown in Figure 4. The gillnet was dominant, but contributed the least to the total tuna catch in 2011. It was vice versa for the purse seine

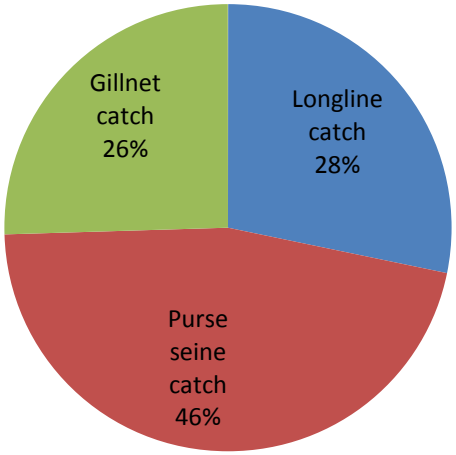

Figure 4. Tuna catches from different fishing gears in Vietnam in 2011
(DECAFIREP, 2012)

In 2011, the longline contributed about 28 percent of total catch, mainly yellowfin and bigeye tuna (Figure 5), those which have had the highest export value among tuna species. The longline fishery appears only in the three central provinces of Vietnam: Khanh Hoa, Binh Dinh, and Phu Yen.

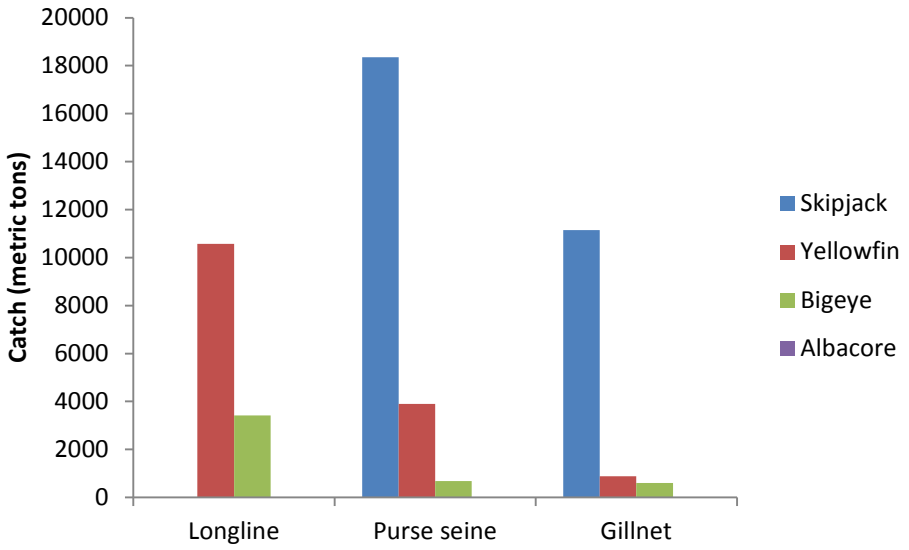

Figure 5. Catch composition of tuna fishing gears in 2011
Data from (DECAFIREP, 2012)

3.4 Tuna fisheries management

3.4.1 Legal framework

There is not any specific regulation for tuna fisheries, however, some parts of the legal frameworks for fisheries management have been considered as management tools for tuna fisheries (Anon, 2011b). The fisheries law was promulgated on 01 July 2004 and was apparently intended to serve as the main

instrument for national living aquatic resources management. However, there are detailed regulations provided instruments on many aspects of the fisheries management, including tuna fisheries, namely Decree No. 33/2010/ND-CP issued on 31 March 2010 by Prime Minister about fishing activity management of Vietnamese organizations and individuals operating at sea and Circular No. 48/2010/TT-BNNPTNT issued on 11 August 2010 about stipulating detail guidelines of the Decree No. 33/2010/ND-CP. These instruments include allowable concentrations of toxic substances in waters inhabited by aquatic organisms, minimum permitted mesh sizes by gear type, prohibited species, area closures during spawning seasons and minimum size regulation as well as specific requirements of fishing boats to follow regulations on filling their logbook. Recently, Circular No. 28 /2011/TT-BNNPTNT issued on 15 April 2011 about catch certification for fishing products to be exported to EU markets is also a very important legal framework for tuna management especially for fisheries products which is exported to EU countries (Anon, 2011b).

3.4.2 Institutional arrangements for tuna fishery management

3.4.2.1 Data related arrangements

Tuna fisheries data is collected through three main sources: indedendent surveys, obsevation program and logbooks. The independent surveys and observation program are carried out through research projects, mainly by RIMF. The logbook program has been implemented in Binh Dinh, Khanh Hoa, and Khanh Hoa provinces through WPEA-OFM project. The statistic system in Vietnam currently provide aggregate figures for all marine species, it does not target for individual species like tuna.

3.4.2.2 Science bodies:

Agencies involved in fisheries research include Scientific, Technological and International Cooperation Department under the General Directorate of Fisheries and Science, Technology and Environment Department under Ministry of Agriculture and Rural Development. RIMF, a research institute under the General Directorate of Fisheries, often carry out tuna fisheries research.

3.4.2.3 Monitoring, Control and Surveillance (MCS) *related agencies:*

There are two agencies involving in MCS in Vietnam's sea area: fisheries inspection and Vietnam marine police. Vietnam Marine Police is the coast guard of Vietnam. It provides protection and assistance to local fishermen when necessary. Fisheries inspection falls under the management of Deretorate of Fisheries. It currently has 92 patrol boats with total capacity of 21,000 HP. The patrol fleet includes 5 boats with engine of higher than 600 HP, 8 boats with engine between 500 to 600 HP, and the rest with engine of lower than 450 HP (DECAFIREP, 2012).

3.4.2.4 Tuna fisheries management plan:

Tuna fisheries management has not been implemented. DECAFIREP has drafted tuna fisheries management plan and it needs to be approved by the General Directorate of Fisheries and Ministry of Agricultural and Rural Development.

4. Tuna fisheries environment overlapping in three provinces

4.1 Fishing grounds and fishing seasons

According to Son (2005), yellowfin tuna and bigeye tuna distribute concentratedly in the three main

areas: the offshore waters of Binh Dinh and Phu Yen limited by longitude of 110°30E-112°00E and latitude of 12°00N-13°30N; the water of Khanh Hoa province (110°00E-112°00E, 12°00N-13°00N) and the westen area of Spratly Island (110°00E-112°00E, 8°00N-10°00N). Skipjack concentrate in some areas including Phu Yen's seatwater (109°30E-111°30E, 12°00N-14°00N), area from Khanh Hoa to Binh Thuan water (110°30E-112°30E, 11°00N-12°00N) and offshore water of Vung Tau province (109°00E-111°00E, 8°00N-10°00N). Tuna fishing grounds are divided into 2 distinct areas corresponding to the fishing seasons. In the northeast monsoon season which occurs from November to April, tuna fishing grounds situated in the north of the East Sea and near Paracel Island (14^0N - 16.30'N and 112^0E - 115.00'E), where the average depth of the highest areas ranging from 400 - 4000 m. In this season, catches are often higher than they are in the other months; the highest catches are normally observed during the period from December to February each year. In the southwest monsoon, tuna fishing boats moved to the south of the East Sea and the Spratly Islands (06.00'N - 11.30'N and 108.00'E - 113.00'E), where the average depth is from 200 – 3,000m (Figure 6). A few tuna fishing boats still operate fishing in the area from Quy Nhon to Nha Trang, with trip duration usually lasting from 7-15 days. Catches in the southwest monsoon are not as high as it in the northeast monsoon and the quality of fish is lower as well. According to experiences of fishermen, in the northeast monsoon, tuna usually distributes more in upper water layer than in the southwest monsoon. Tuna are caught from April to August in the South of the East Sea, Spratly Islands and near the seamounts. Fishing grounds of drift nets also have seasonal characteristics. Many gillnet boats of the Central area move to the Gulf of Tonkin, where the depth contours of 20 - 60 m for fishing mackerels during November - March on the lunar calendar, while the other boats are fishing tuna and common dolphin fish in the central waters of Vietnam. From April to August, the fleets usually operate in the areas stretching from Da Nang to Vung Tau. In the other months, these fleets operate, mainly in the coastal area of Binh Dinh and Phu Yen or stop fishing for repairing boats and gears due to the bad weather conditions. Higher catches are usually achieved in the two main periods from December - January and from July – August annually (RIMF, 2011).

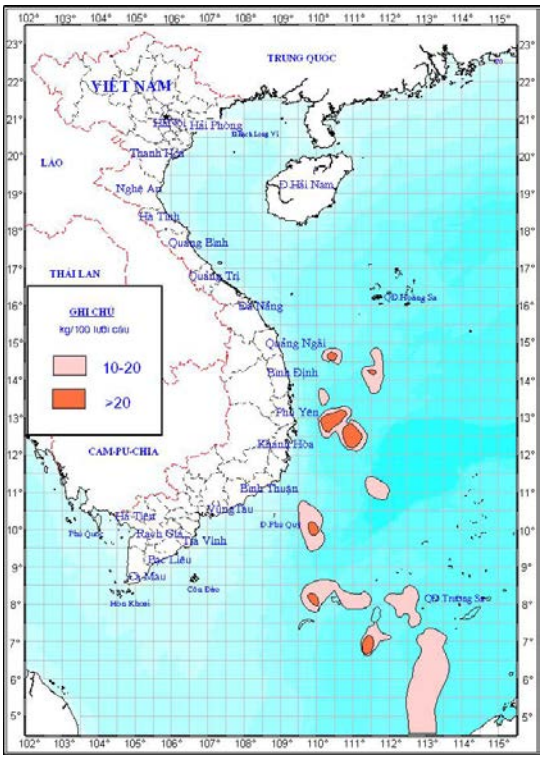

Figure 6. Tuna fishing grounds in the northeast monsoon from 2000 to 2004
Source: (Son, 2005)

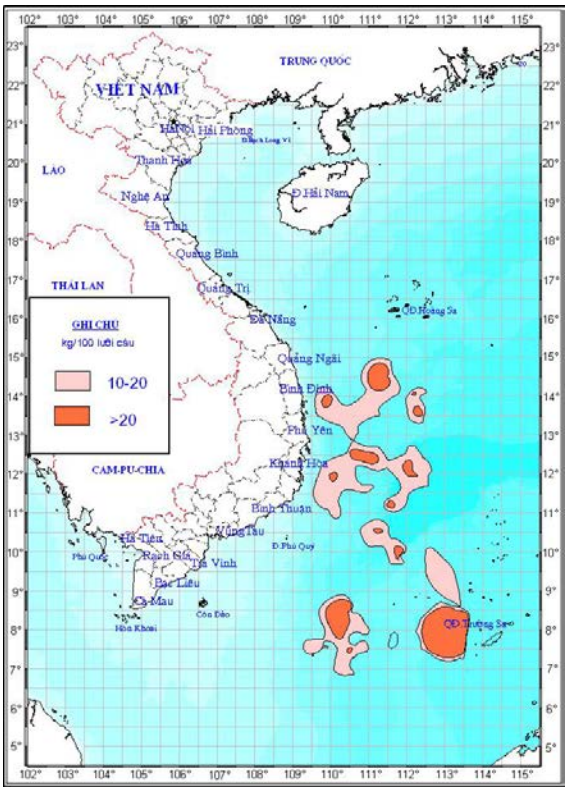

Figure 7. Tuna fishing grounds in the southwest monsoon from 2000- 2004
Source: (Son, 2005)

4.2 Fishing gears and fishing techniques

Drift longline is the main fishing gear for harvesting yellowfin tuna and bigeye tuna in the three central provinces. Longlines are composed of many sections or "sets". Each set measures 50 to 60 meters in length, with four to six branch lines each bearing one hook. The branch line consists of three sections and each branch line is attached with a special snap-on mental clip to the main line (Figure 8). The size of longlines used by fishers reached 40-50km and the catching depth was around 40 to 60 meters (Long, 2001; Toan, 2011). However, only a few boats are equipped with line collecting devices, making the line collection process still slow, and the fishers have to work very hard to complete this process. A number of boats still collect the line manually, thus the line dropped down is short and economic efficiency gained is low.

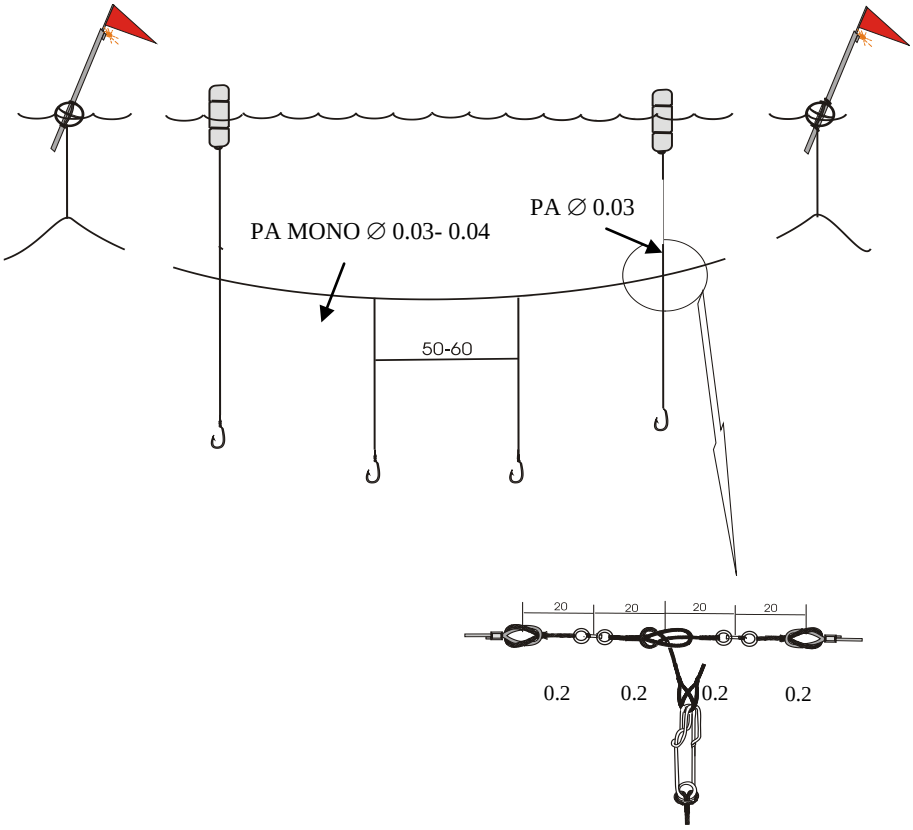

Figure 8. A section of the drifting tuna long-line
(Long, 2001; Long *et al.*,, 2002; Toan, 2011)

Fishing process include the following main steps: shooting main lines, branch lines and hooks; soaking lines; detecting hooked tuna; and taking tuna on boat. Shooting lines normally takes about 2 - 3 hours depending on number of hooks, while soaking lines usually takes about 5 - 8 hours depending on the time of shooting (Toan, 2011).

4.3 Tuna value chain

Figure 9 shows a typical value chain for tuna fisheries in the three central provinces. The value chain shows that the harvested tuna is mainly for export. Tuna fishers tend to sell their products to the same traders with whom they have established relationships, trust and mutual support (McCoy et al., 2010). Traders sort and classify the fish and transport it to the processing companies. Majority of tuna products are sold to foreign importers. Quantities purchased for the domestic market are often quite small. For the domestic market, intermediate dealers, who are often relations of the traders, enter the chain (McCoy et al., 2010).

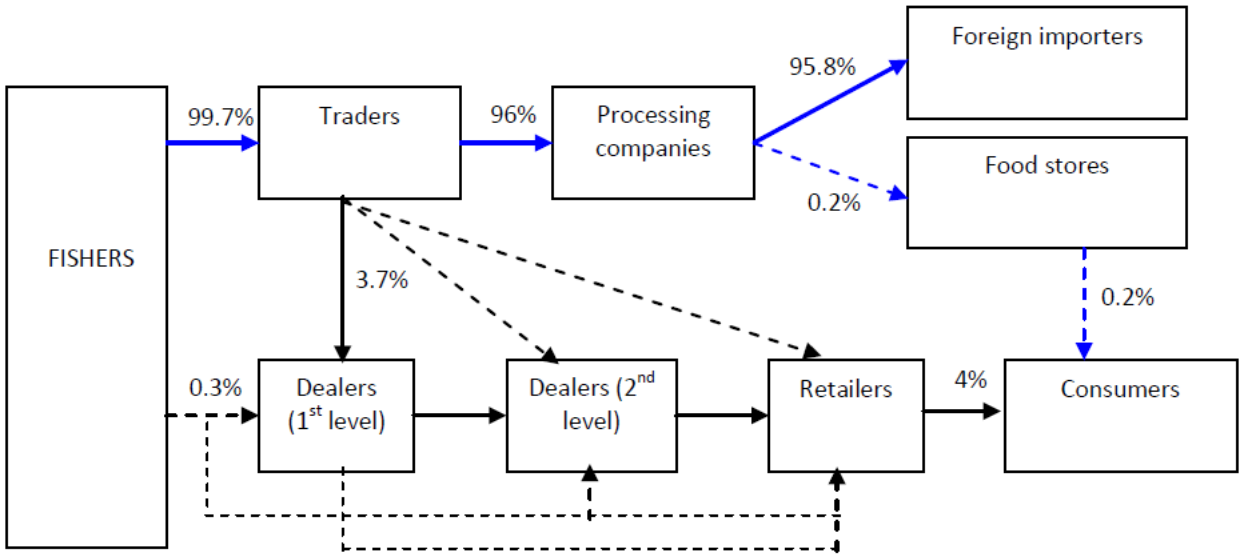

Figure 9. Skipjack tuna value chain in Khanh Hoa province
Source: (McCoy et al., 2010)

Chapter 2. Binh Dinh's Tuna Fisheries Profile

1. Introduction

Fisheries play an important role in Binh Dinh province. This comes from its natural and social characteristics with the specific potentials and advantages, which can be exploited to contribute to strengthening the province's economic development. Binh Dinh has a long coastline, with many estuaries such as Quy Nhơn, Đề Gi, Tam Quan, Hà Ra - Phú Thứ and An Dũ. The province has about 2,500 km^2 of territorial waters and above 40,000 km^2 of exclusive economic zone. It has abundant marine resources with many species of high commercial value such as mackerel, snapper, grouper, oceanic tuna, shrimp, and squid. In addition, there are many rare and special commodities such as: bird's net, true eel or shortfin eel (*Anguilla bicolor*), lobster, crabs, sea and cucumber that are favored by both domestic and international high-value markets. In 2011, total catch of fisheries was estimated about 152,109 MT, contributed about 8.6 % of GDP of Binh Dinh province. Marine capture fishery is a traditional livelihood in Binh Dinh with the traditional fishing gears such as purse seine, longline, gillnet, and trawl net. Fishers in Binh Dinh have experience in fishing and they carry out fishing in all fishing areas nationwide. Tuna fisheries have recently played an important role in Binh Dinh province. In 2011, the total tuna catch was 38,887 metric tons accounted for about 26% of the total marine catch in Binh Dinh province, in which the yellowfin and bigeye tuna accounted for about 12%.

Binh Dinh is also famous for its skilled workers in the field of fishing boatbuilding and repair. The boatbuilding facilities in Binh Dinh have developed to meet the needs of fishing boats of not only Binh Dinh but other provinces in the country. Some plants are capable for building the boats with capacity of 500 - 700 HP and involve the initial application of hull fiber composite technology. Currently, Binh Dinh has a relatively strong fishing fleet. Total motor- fishing boats are more than 6,000 units, of which, offshore fishing boats accounts for about 59%. Fishing equipment in Binh Dinh has been mechanized and modernized - 70% fishing boats are equipped with communication equipment, 60% boats equipped with satellite navigation, 40% boats are equipped with echo sounder, fish finder. As a result fishing productivity is increasing more and more.

The seafood processing industry in Binh Dinh is also developing quite well. Most processing plants have invested in innovations of equipment and technology and applied quality management systems, advanced food safety and hygiene to meet the required quality standards for export with the diversity of processed products: fresh, dried, frozen seafood products export to Japan, EU, US, China and the Southeast Asia. Fisheries logistics and support service center have also recently seen significant investment. The fishing ports, fish markets, shelters have been upgraded. The quarantine and environmental monitoring stations, sections of testing antibiotic residue and other toxic substances in seafood products, testing laboratories, and seafood quarantine have been built and put into more efficient operation. With the favorable conditions of nature and society, together with the special attention from the Province's leaders, fishery sector in Binh Dinh has been playing an important role in the structure of the province's economy. A reasonable development strategy together with preferential investment policies will be the force to arouse the potential of the fisheries sector in Binh Dinh.

2. Background information

Binh Dinh is a coastal province in South Central Viet Nam (Figure 10). Its territory extends 134 km in the North-South direction, with the average width of 55 km (the narrowest is 50 km, and the widest is 60 km). It is bordered by Quang Ngai Province to the north, by Phu Yen Province to the south, by Gia Lai to the west and by East Sea to the east. The easternmost point is in Nhon Chau commune (Cu Lao Xanh),

Qui Nhon city. Binh Dinh is considered as a gateway to the sea for Central Highlands and Southern Laos. Binh Dinh has 1 city and 10 districts with 161 communes/wards and towns; the natural area is 6,039 km^2. According to General Statistics Office of Vietnam (GSO) in 2011[4], Binh Dinh is the third biggest province in term of population in the North Central Area and Central Coastal Area following Thanh Hoa and Nghe An provinces, with the population was about 1.5 million people, of which men accounted for 48.75% and women accounted for 51.25%. Urban population was 27.74% and rural population was 72.26%. Average population density is 247 people per km^2. Working age population were about 880 thousand people, accounting for 58.8% of the population. General information about Binh Dinh province is shown in box 1.

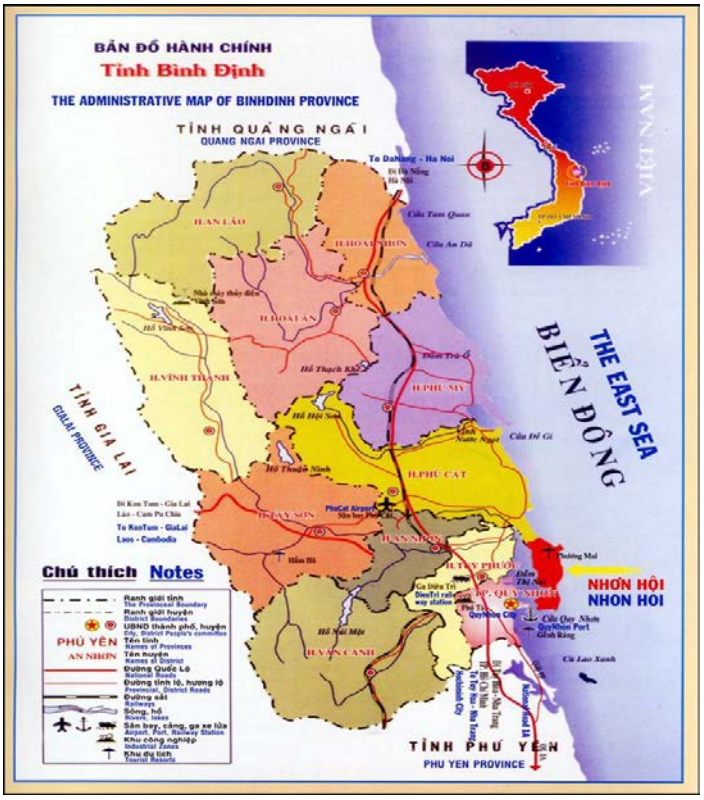

Figure 10. The map of Binh Dinh Province

Box 1. General information about Binh Dinh province in 2011 (GSO, 2012)

Location: ***South Central Coast Region;***
Area: ***6,039 km^2;***
Population: ***1.5 million;***
Monthly Average Income per Capita (2010):***1150 thousand VND (~60 USD);***
Marine Fishery Production: ***116.4 thousand MT (6.7% of the whole country);***
Number of offshore fishing vessels: ***3827 (13.5% of the whole country);***
Total capacity of offshore vessels: ***256.6 thousand HP (4.9% of the whole country)***
Gross Output of fishing: ***1487.4 billion VND (2.5% of the whole country).***

[4] http://www.gso.gov.vn/default_en.aspx?tabid=515&idmid=5&ItemID=12576

3. Tuna fisheries

Tuna resources have been harvested in Binh Dinh by offshore gillnets and shark longlines since 1974. However, in the early days, tuna was considered as a bycatch product due to lack of tuna markets and low market prices. Tuna longline fishery has appeared in Binh Dinh since 1993 and it has strongly developed since 1997 when the national offshore fishing program was promoted. There are 65 tuna longline boats have been built, accounted for about 68% of total number of boats has been built in the offshore fishing program in Binh Dinh. In 1996, there were only 60 tuna longline boats but in 2007 there were 700 tuna longline boats in Binh Dinh province. Since the end of 2011, tuna handlines using lights (Figure 11) have been developed from tuna longliners and become popular in Binh Dinh due to high production and longer fishing season (almost whole year). The catch of tuna handlines is about 1.5 to 2 MT per 20 day-trip. There are currently (2012) 1060 tuna handline boats in Binh Dinh. Tuna purse seine fishery is also an important fishery in Binh Dinh. In 2012, there are 786 tuna purse seine boats, in which 270 boats are offshore daytime purse seine targeting skipjack tuna.

3.1 Tuna fleet

Longline/handline, purse seine and gillnet are main gears for tuna fisheries. Figure 12 shows tuna fleet in Binh Dinh province. Tuna longline and tuna purse seine boats have significantly increased for the last three years. Numbers of tuna longline and tuna purse seine boats increased about twofold and threefold respectively from 2010 to 2012. At the same period, tuna gillnet decreased over twofold.

Figure 11. Tuna handline using lights in Binh Dinh province
(photos taken by Nguyen Hai Binh in 2012)

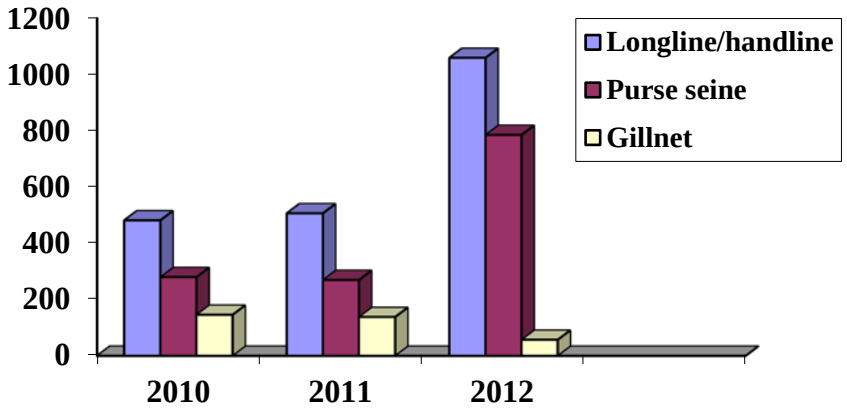

Figure 12. Tuna fleet in Binh Dinh province
Source: (Binh, 2012)

Table 1 shows the structure of tuna fleet in Binh Dinh. Tuna longline boats with engine from 90 to 150 HP and tuna purse seine boats with engine from 150 to 250 HP have increased over tenfold and fourfold respectively for the last three years.

Table 1. Structure of tuna fleet in Binh Dinh from 2010 to 2012
Source: (Binh, 2012)

Capacity	**Longline/handline**			**Purse seine**			**Gillnet**		
	Longline	Longline	Handline						
	2010	2011	2012	2010	2011	2012	2010	2011	2012
<45 HP	23	14	48	62	56	0	72	71	2
45-89 HP	48	24	77	30	16	4	22	23	3
90-149 HP	30	22	328	16	13	42	6	3	14
150-249 HP	207	206	462	44	43	199	16	15	22
250-399 HP	171	214	94	115	125	434	28	24	12
≥400 HP	3	27	51	13	17	107	2	2	4
Total	**482**	**507**	**1060**	**280**	**270**	**786**	**146**	**138**	**57**

3.2 Tuna cach

3.2.1 Tuna catch estimates

In 2011, the total tuna catch was estimated approximately 38,887 metric tons accounted for about 26% of the total marine catch in Binh Dinh, in which the yellowfin and bigeye tuna accounted for about 12%.

3.2.2 Catch rate

Results of data collection from longline fishing logbook in Binh Dinh during 2000 - 2009 showed that the catch rates (CPUE) of large pelagic fishes fluctuated periodically, but not clearly showing and up or down trend. From mid 2003 to early 2005, the average catch rates of large pelagic increased steadily, from 20 kg per 100 hooks in August/2003 to over 50kg per 100 hooks in Jan/2005. From Apr/2005 up to now, this index was relatively stable, mainly fluctuating around 30 kg per 100 hooks (Figure 13). At some other time, catch rates of these species suddenly increased and then decreased just s dramatically; however, over the period of time here (2003-2009), the catch rates of large pelagic group captured by longline fisheries have remained relatively stablility.

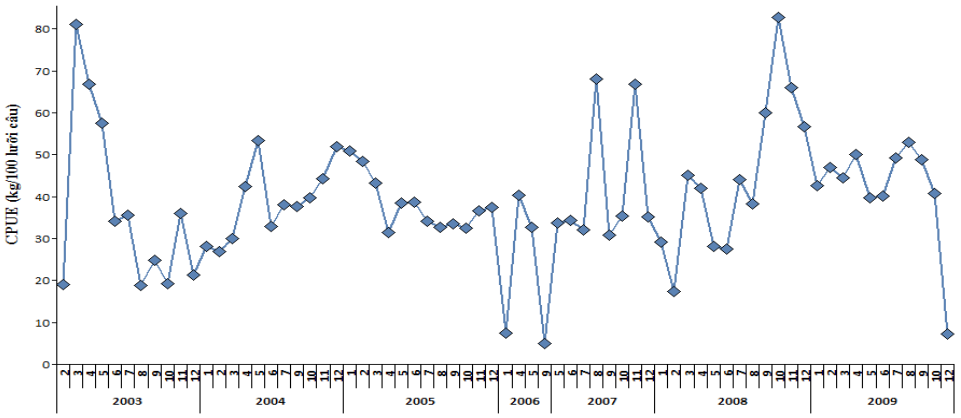

Figure 13. Variation in catch rate of tuna longline boats in Binh Dinh (RIMF, 2011)

3.2.3 Catch composition

Table 2 shows tuna catch composition of different fishing gears. BY and YF tuna were dominant in longline/handline catch and SKJ tuna was dominant in purse seine and gillnet catch from 2010 to 2012. BY tuna has decreased while YF tuna has increased in longline/handline catch.

Table 2. Catch composition of tuna fisheries from 2010 to 2012

Year	Longline/handline		Purse seine			Gillnet		
	BY(%)	YF (%)	SKJ(%)	BY(%)	YF(%)	SKJ(%)	BY(%)	YF(%)
2010	56.70	43.30	-	-	-	-	-	-
2011	23.50	76.50	68.14	7.98	4.93	67.70	0.95	0.04
2012	27.40	72.60	70.33	9.25	4.61	47.50	8.08	0.07

(Data from WPEA OFM Project)

3.3 Tuna trade and consumption

For the tuna fishery, the triangle formed through distribution amongst boat owners – middlemen – consumers or producers is becoming popular (Figure 13). That relationship has created a free activity because neither party was forced to sell or buy from a single host at a single place. With mobile media, boat owners can collect and process information while boat is operating at sea. They clearly know the market prices at tuna collecting places that are near their fishing grounds then they can quickly decide where they should sell their catches.

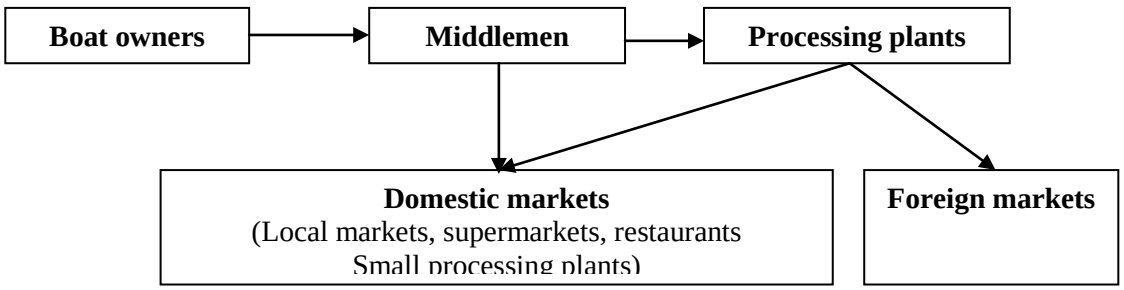

Figure 14. Tuna market chain in Binh Dinh province
(Binh, 2012)

3.4 Tuna fisheries labor

In Binh Dinh province, there are about 8 to 10 fishers working at each tuna longline/handline, purse seine and gillnet fishing boat and there are around 1,900 fishing boats for such fisheries. So total fishing labors can be estimated as 16,200 to 19,000 fishers employed in tuna fishery. Economics data of tuna fisheries (average per boat) in 2012 may be roughly estimated as follows (personal communication with Binh Dinh Sub-DECAFIREP office):

a) Tuna longline/handline boat:

- Each fishing trip: 20 days (for offshore fishing grounds of the Central area); 30 days (for fishing grounds in Southern Spartly Islands)
- Number of fishers: 6-8 persons (handline using lights) 10-12 persons (longline)
- Total cost per trip: 110 to 140 millions VND
- Total revenue: 150 to 250 millions VND
- Average income per fisher: 5-7 million VND per trip

b) Tuna purse seine boat:

- Each fishing trip: 15-25 days
- Number of fishers: 12 persons
- Total cost: 80 to 140 millions (depending on the size of boat)
- Total revenue: 250 to 350 millions VND.
- Average income per fisher: 6-10 millions VND

c) Tuna gillnet boat:

- Each fishing trip: 5-15 days
- Number of fishers: 6-8 persons
- Total cost per trip:10 to 30 millions VND
- Total revenue per trip: 20 to 60 millions VND.
- Average income per fisher: 1.5 to 3 millions VND.

4. Tuna fisheries infrastructure

4.5 Tuna fishing harbors

Along the coast of Binh Dinh, there are three large inlets and landing sites for tuna fisheries, namely Qui Nhon, De Gi and Tam Quan Bac. There are also 26 fishing villages, situated on the promontories, small coastal islands, and lagoons. Landing sites and fishing harbors in Binh Dinh generally are informal, with insufficient of investment in the construction of logistics facilities services.

Quy Nhon harbor belongs to the system of national commercial harbors with the stable access channel. Due to the impact of waves and monsoon, Tam Quan and De Gi fishing harbors are often shallow and getting more and more narrow, so it is difficult for large boats are to come in and out and accidents occur.

Landing sites are inadequate in terms of investment in infrastructure; fish are usually carried to the shore by bamboo coracles or small artisanal boats. Main technical characteristics of tuna fishing harbors

in Binh Dinh are described as follows:

a) *Quy Nhon fishing harbor (data from the harbor authority in 2012):*
   - Length: 510m
   - Area: 34.000 m^2 (old harbor 5.000m2, new harbor 29.000m^2)
   - Harbor cold storages: 40 MT (Storage 1: 10 MT; Storage 2: 30 MT)
   - Buildings: 1200 m^2
   - Capacity: 13,000 landed boats in 2012
   - Catch landed in 2012: 60,000 MT
   - Usage: mainly for tuna purse seine and tuna gillnet boats

Figure 15. Quy Nhon fishing harbor
(photos taken by Nguyen Hai Binh in 2012)

b) *Đề Gi harbor (data from the harbor authority in 2012):*
   - Length: 50m
   - Area: 14.000m2
   - Harbor cold storages: non
   - Buildings: non
   - Usage: mainly for small tuna purse seine boats using lights

c) *Landing sites in Tam Quan, Hoai Nhon, Binh Dinh (Data from Binh Dinh sub-DECAFIREP in 2012)*

There are 10 landing sites in Thien Chanh village, Tam Quan district. Each landing site has the following technical characteristics:
   - Whalf length: 50m,
   - Area: 200m^2
   - Building: 100m^2
   - Harbor cold storages: non
   - Usage: mainly for offshore tuna longline/handline boats

4.6 Processing plants

There are currently 05 processing plants involved in fish products in Binh Dinh province:
   - Binh Dinh fishery Joint Stock company (Công ty cổ phần thủy sản Bình Định)
   - Hoai Nhon Fishery Joint Stock Company (Công ty cổ phần thủy sản Hoài Nhơn)

- Quy Nhon Frozen Seafoods Joint Stock Company (Công ty cổ phần đông lạnh Quy Nhơn - F16)
- Quy Nhon Food Company (Công ty thực phẩm Quy Nhơn)
- Lam Son Food Import Export Company (Công ty thực phẩm xuất nhập khẩu Lam Sơn).

However, there has been only Hoai Nhon Fishery Joint Stock Company involved in tuna processing since 2010. Tuna products include frozen BY and YF, are not main products of this company. The company can store 30 to 40 MT of frozen fish per day. It's raw materials are bought from both domestic (about 900 MT of tuna in 2012) and foreign markets and it's products are exported mainly to EU and USA markets.

There are 20 companies purchasing tuna raw materials in Binh Dinh province with a half in Tam Quan, Hoai Nhon and a half in Quy Nhon. The five biggest companies are listed in Table 3.

Table 3. List of five biggest companies purchasing tuna raw materials in Binh Dinh in 2012
(Binh, 2012)

No	Company	Location	Target species
1	Tan Xuan Loc Limited Company (Công ty TNHH Tân xuân Lộc)	Tam Quan Bac, Hoai Nhon	BY, YF
2	Hai Nguyen Limited Company (Công ty TNHH Hải Nguyên)	Tam Quan Bac, Hoai Nhon	BY, YF
3	Hai Ha Limited Company (Công ty TNHH Hải Hà)	Tam Quan Bac, Hoai Nhon	BY, YF
4	Yen Thu Limited Company (Công ty TNHH Yến Thu)	Tam Quan Bac, Hoai Nhon	BY, YF
5	Ba Huynh Limited Company (Công ty TNHH Ba Huynh)	Quy Nhon	SKJ

4.7 Boatyards

There are 10 boatyards in Binh Dinh in 2012. These boatyards both build and repair fishing boats including tuna longline/handline, purse seine, and gillnet boats. Table 4 shows the list of these boatyards and their capacity.

Table 4. List of Boatyards in Binh Dinh in 2012
(Binh, 2012)

No	Name	Location	Area	2012	
				New boats	Repaired boats
01	Tam Quan Boatyard Factory (Xí Nghiệp đóng tàu T.Quan)	Tam Quan Bắc, Hoài Nhơn	21.200 m^2	140	10
02	Bay Thuan Boatyard (Cơ sở Bảy Thuận)	Tam Quan Bắc, Hoài Nhơn	4.000 m^2	25	9

03	Huu Hoa Boatyard (Cơ Sở Hữu Hòa)	Mỹ Thành, Phù Mỹ	2.750 m^2	9	0
04	Ngoc Chau Limited Company (C.ty TNHH Ngọc Châu)	Cát Minh, Phù Cát	2.860 m^2	01	01
05	Vo Van Van Private Company (DNTN Võ Văn Vân)	Cát Khánh, Phù Cát	4.200 m^2	0	0
06	Quy Nhon Fishery service Factory (Xí Nghiệp KD DVTS Q. Nhơn)	405 đường Đống Đa, Quy Nhơn	4.800 m^2	07	0
07	Binh Dinh Navigation Joint Stock Company (Xí nghiệp ĐM&SC tàu sông biển- Cty Cổ phần Hàng Hải Bình Định)	78 Trần Hưng Đạo, Quy Nhơn	10.000 m^2	05	0
08	Trung Tam Limited Company (Công ty TNHH Trung Tâm)	87 Phan Chu Trinh, Quy Nhơn	4.100 m^2	12	0
09	Hai An Private Company (DNTN Hải Sơn)	54 Hoàng Quốc Việt, Quy Nhơn	4.500 m^2	01	0
10	Thanh An Private Company (DNTN Thành An)	258 Lê Hồng Phong, Quy Nhơn	4.500 m^2	08	0

5. Tuna Fisheries management

5.1 Organizational structure

Tuna fisheries in Binh Dinh are directly managed by Binh Dinh sub-DECAFIREP. It is a unit under the provincial Department of Agriculture and Rural Development (PDARD). Functional divisions under Binh Dinh sub-DECAFIREP include:

- Administration
- Fishing boat management and Fishery logistic services
- Capture fisheries and Information Management
- Fisheries Marine Resources and Environment Management
- Inspection Division

In addition, sub-DECAFIREP has 4 stations for fisheries exploitation and resource protection in different locations, including: Hoai Nhon and Tuy Stations.

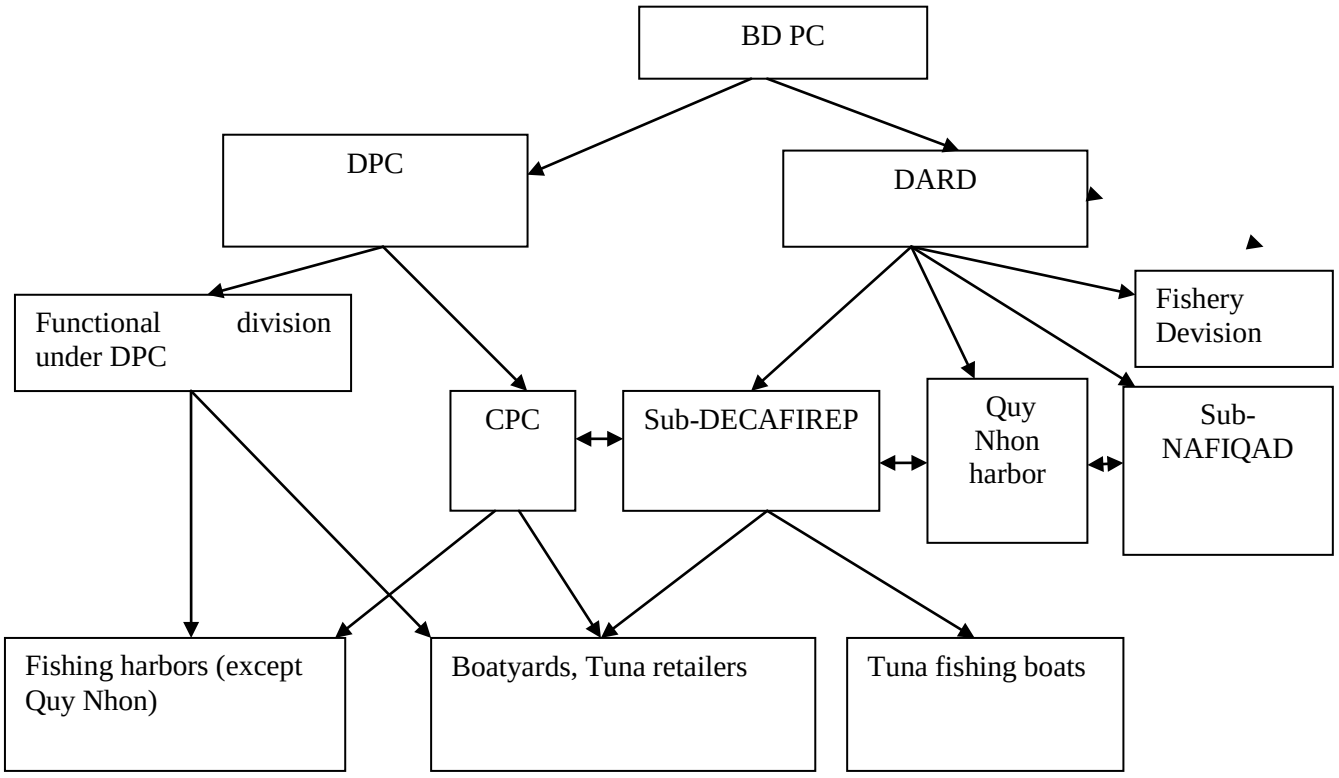

Figure 16. Related bodies for tuna fisheries management in Binh Dinh
Source: (Binh, 2012)

Note: BD PC – Binh Dinh People's Committee; DPC – District People Committee; CPC – Commune People Committee; DARD – Department of Agriculture and Rural Development

5.2 Legal framework

Binh Dinh does not have any specific policy for tuna fisheries. National legal framework is applied for tuna fisheries in Binh Dinh province.

5.3 Data collection

Data collection for tuna fisheries is described in Figure 17. Tuna fisheries data include catch, biological data, and logbooks.

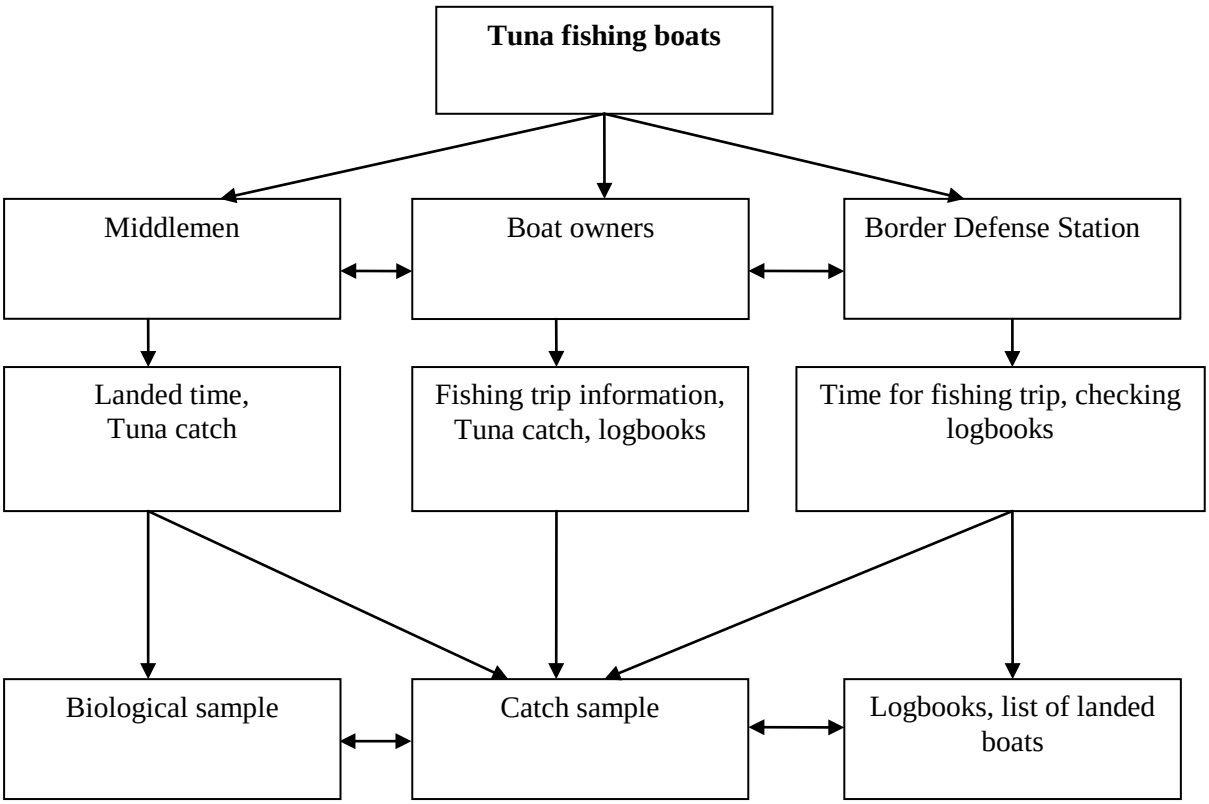

Figure 17. Tuna fisheries data collection in Binh Dinh province
(Binh, 2012)

Five staff from sub-DECAFIREP have collected tuna fisheries data in Tam Quan and Quy Nhon harbors. Numer of samples are shown in Table 5.

Table 5. Data collection for tuna fisheries in Binh Dinh
(Data from WPEA OFM Project, 2012)

	Purse seine			**Gillnet**			**Longline/handline**			
Year	**BS**	**CS**	**NV**	**BS**	**CS**	**NV**	**BS**	**CS**	**LB**	**NV**
2010							60	197	58	216
2011	35	207	352	6	44	72	218	1112	1301	2036
2012	216	814	1,292	0	48	65	194	1,138	899	5,070
Tổng	**251**	**1,021**	**1,644**	**6**	**92**	**137**	**472**	**2,447**	**2,258**	**7,322**

Note: BS – Biological sample; CS – Catch sample; NV – Number of boats; LB – Logbooks.

Chapter 3. Phu Yen's Tuna Fisheries Profile

1. Introduction

Phu Yen is a coastal province in the South Central Coast of Vietnam. It has the coastline of 189 km and a slope seabed with the depth of more than 100 m. There are many reefs in continential area near the coast of Phu Yen province. Marine resources in Phu Yen's sea waters are abundant in terms of number of aquatic species identified, with 500 fish species, 38 species of shrimp, 15 squid species and other such as scallops, bird's nest. Main species in coastal areas include sardine, anchovy, yellow stripe trevally, goatfish, lizardfish, and threadfin bream. Offshore fisheries species mainly are spanish mackerel, tuna, billfish, common dolphin fish, threadfin porgy, flying fish.

Phu Yen is a traditional fishing province, with a large fishing fleet. In 2011, there were 7273 fishing boats with total 20,450 fishers in Phu Yen province, of which, boats with the engine of smaller than 20 HP accounted for about 64 % and derived in the province (Anon, 2011a). There are 4 main fishing gears in Phu Yen province: gill nets, trawls, purse seines and tuna longline, of which, gill nets formed the largest proportion, presenting 61.62%; in descending order were trawls 8.92%; tuna longline 7.12% and purse seine 4.98% total fishing boats in Phu Yen province (RIMF, 2011). In 2011, total catch of fisheries in Phu Yen province was approximately 55,031 metric tons (Nhan, 2012).

Among offshore fishes, tunas are the most noteworthy, because of their high commercial value, especially yellowfin tuna and bigeye tuna. Total landing of these two species was 4,986 metric tons in 2010 and 5684 metric tons in 2011(Nhan, 2012). Tuna has been exploited by 3 main fishing gears: gill net, purse seine and longline. In 2011, there were 831 tuna boats, in which longline boats accounted for about 67 %, tuna purse seine accounted for 15.5% and gillnet accounted for 17.4% of the total number of tuna boats (Nhan, 2012). Tuna longline boats are mainly registered in Tuy Hoa city and Tuy An District, Phu Yen province.

2. Background information

Phu Yen is a coastal province in the South Central Coast of Vietnam, expanding from12°42'36" - 13°41'28" North latitude and from 108°40'40" - 109°27'47" East longitude with total area of 5,045 km^2. Phu Yen borders Binh Dinh province to the north, Khanh Hoa province to the south. Đak Lak and Gia Lai to the west, and the East Sea to the east. Phu Yen has 1 city, 1 town and 7 districts with the natural area is 5,045 km^2. According to General Statistics Office of Vietnam (GSO) in 2011, Phu Yen's population was about 0.87 million people, of which men accounted for 50.05% and women accounted for 49.95%. Urban population was 23.24% and rural population was 76.76%. Average population density is 172 people per km^2. Working age population were about 513 thousand people, accounted for 58.85% of the population. Phu Yen has a river system with total length of 2,600 km, area of water surface is about 10,000 ha. The main rivers flow across Phu Yen are Da Rang River (the largest river in Central Vietnam), Ban Thach river and Ky Lo river with the watershed of 16,400 km^2, total flow of 11.8 billion m^3.The province's EEZ is of about 6,900 km^2 with 9 big and small islands, the significance are Hòn Lao, Hòn Chùa, Hòn Than, Hòn Yến, Hòn Dứa, Hòn Khô. The seabed is sloping, more and more to the south. In the north of the province, Continental slope is from 0.35% – 0.45%, 100m depth and far from the coast about 18 – 19km. In the south of the province, continental slope is from 1.4% - 2.8%, 100m depth and far from the coast from 3.5 km (Ke Ga point) – 7.0 km (Da Rang Estuary). A summary of information about Phu Yen province is shown in box 2.

Figure 18. The map of Phu Yen Province

Box 2. General information about Phu Yen province in 2011 (GSO, 2012)

Location: ***South Central Coast Region;***
Area: ***5,045 km^2;***
Population: ***0.87 million;***
Monthly Average Income per Capita (2010): ***1013 thousand VND (~55 USD);***
Marine Fishery Production: ***38.9 thousand MT (2.3% of the whole country);***
Number of offshore fishing vessels: ***1444(5.1% of the whole country);***
Total capacity of offshore vessels: ***124.9thousand HP (2.4% of the whole country)***

Gross Output of fishing: ***720.4 billion VND (1.2% of the whole country).***

3. Tuna fisheries

3.1 Tuna fleet

Tuna fisheries have strongly developed in Phu Yen since 1997 when the national offshore fishing program was promoted. Longline, purse seine and gillnet are main fishing gears for tuna fisheries in Phu Yen. In 2011, there were 831 tuna boats, in which longline boats were dominant, account for about 67 %, tuna purse seine account for 15.5% and gillnet account for 17.4% of the total number of tuna boats. Table 6 shows structure of tuna fleet in Phu Yen province. Longline boats with engine of higher than 90 HP (offshore boats) were dominant, accounted for about 92% of the total tuna longline vessens and 62% of the tuna fleet of Phy Yen province. Among tuna gillnetters, boats with engine power of above 90 HP

account for 10.4%. Gillnetters in Phu Yen concentrate in Tuy Hoa City, Tuy An and Dong Hoa District. Target species are mainly small tuna species such as: skipjack tuna, frigate tuna, bullet tuna and other pelagic species.

Table 6. Structure of tuna fleet in Phu Yen

Capacity	Fishing gears					
	Longline		Purse seine		Gillnet	
	2011	2012	2011	2012	2011	2012
<45 HP		0	10	11		
45-89 HP	115	45	57	54	129	135
90-149 HP	64	158	33	36	13	13
150-249 HP	295	247	23	15	2	4
250-399 HP	1	117	0	0		1
≥400 HP		0		1		
Total	475	557	117	129	144	145

3.2 Tuna cach

3.2.1 Tuna catch estimates

In 2011, the total catch of yellowfin and bigeye tuna was estimated approximately 5684 metric tons accounted for about 10.3 % of the total catch of fisheries in Phu Yen Phu yen.

3.2.2 Catch rate

Catch per unit effort (CPUE) of tuna longline and tuna gillnet boats in Phu Yen from 2006 to 2009 are shown in Figure 19. CPUE of tuna gillnet boats decreased about one third from 17.7 kg per km net in 2006 to 11.4 kg per km net in 2009. In the same period, CPUE of tuna longline slightly declined from 19.4 kg/100 hooks to 17.5 kg/100 hooks.

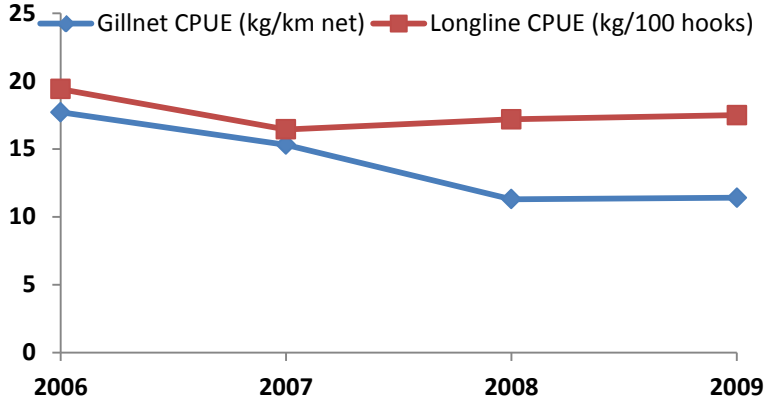

Figure 19. CPUE of longline and gillnet boats in Phu yen from 2006-2009
Source: (RIMF, 2011)

3.2.3 Catch composition

Figure 20 shows tuna catch composition of tuna longline and tuna gillnet boats in Phu Yen from 2010 to 2012. Yellowfin tuna and skipjack tuna were dominant and accounted for 86% and 87% in catches of longline and gillnet boats respectively. Bigeye tuna only accounted for 4% and 14% in catches of longline and gillnet boats.

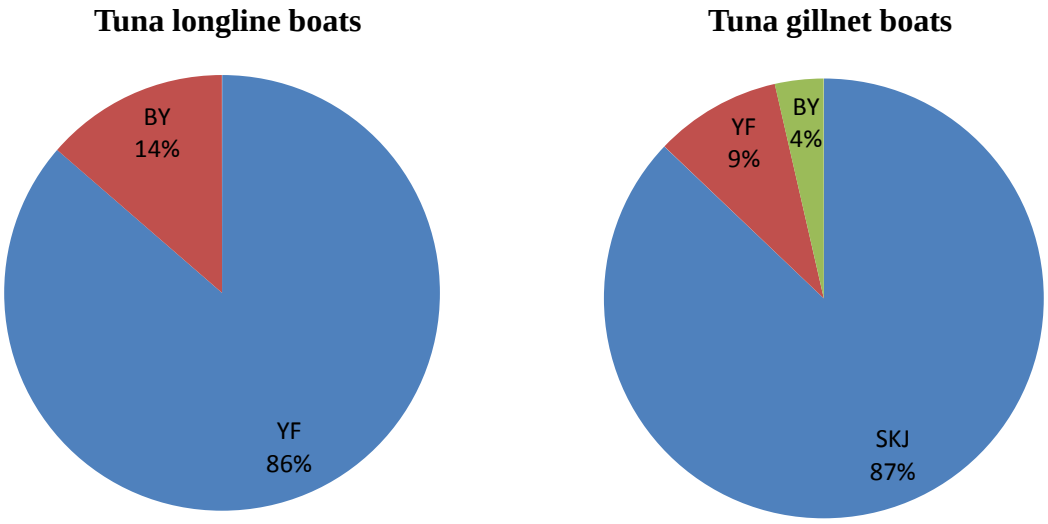

Figure 20. Catch composition of tuna fisheries in Phu Yen from 2010-2012
Source: (data from WPEA OFM Project, 2012)

3.3 Tuna trade and consumption

Figure 21 shows tuna trade and consumption in Phu Yen province. Fishers sell their products to traders (middlemen) at landing sites and harbors. Traders sort and classify the fish and transport it to the processing companies for export (high quality fish) or to local markets (lower quality fish). Some traders may sell the fish directly to foreign importers.

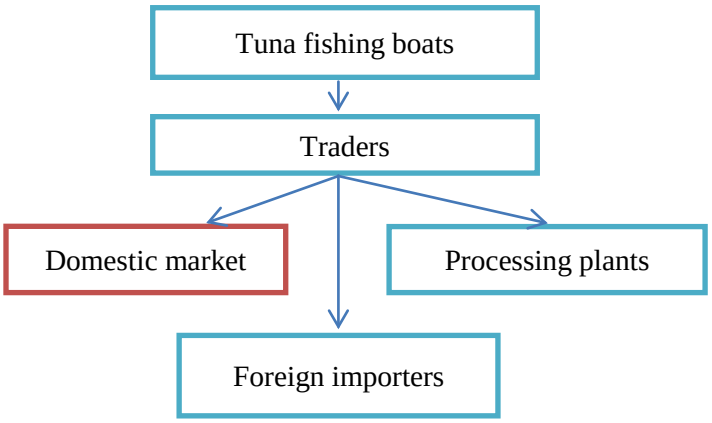

Figure 21. Tuna trade and consumtion in Phu Yen province
Source: (Nhan, 2012)

3.4 Tuna fisheries labor

In Phu Yen province, there are about 8 to 10 fishers working at each offshore tuna longline, purse seine and gillnet fishing boat and there are about 600 fishing boats for such fisheries. So total fishing labors can be estimated as 480 to 600 fishers employed in tuna fishery.

4. Fisheries Infrastructure

4.1 Tuna fishing harbor

Along the coastline of Phu Yen, there are 26 fishing communities and 5 estuaries namely Cu Mong, Tien Chau, Tan Quy, Da Rang and Da Nong. For years, many traditional landing sites have been formulated and somes have been becoming fishing harbors nowaday such as: Tien Chau, Dan Phuoc, Ward 6 fishing harbors. Building fishing harbors are served fishermen community, non-profit purpouse, in order to enhance effectiveness of the marine economy programs including the offshore fishing program. To be aware of this important role, Phu Yen province has completed and developed fishery infrastructure according to the model: there are a wharf, landing places inshore and fish markets and fishery logistic services onshore. Main fishing harbors for tuna fisheries in Phu Yen are described as follows:

- The Ward 6 fishing harbor (Figure 22), located in Tuy Hoa City, has operated since 1996. Capacity of landing at the harbor is about 5,000 metric tons/year, 50 boats with engine power up to 200 HP can be received.
- Dan Phuoc fishing harbor, locatedin Song Cau District, has operated since 2001. Capacity of landing at the harbor is about 5,000 metric tons/year, 50 - 60 boats with engine power up to 200 HP can be received.
- Tien Chau fishing harbor, located in Tuy An district, has opperated since 2006. Capacity of landing at the harbor is about 7,000 metric tons/year, 60 boats with engine power up to 500 HP can be received.

Figure 22. The Ward 6 fishing harbor in Phu Yen province
(photo taken by Tran Ngoc Nhan in 2012)

4.2 Processing plants

There are 10 oceanic tuna traders in Phu Yen province, in which three traders have their own processing plants in Hoa Hiep industrial zone (Dong Hoa district, Phu Yen). Table 7 shows the list of tuna traders in Phu Yen and their markets.

Table 7. List of tuna traders in Phu Yen province
Source: (Nhan, 2012)

No	Name of traders	Market
1	Ba Hai limited company (Cty TNHH Bá Hải)	Domestic, EU markets
2	Loi Anh private company (DNTN Lợi Anh)	US market
3	Khai Vy limited company (Cty TNHH Khải Vỹ)	Domestic and foreign markets
4	Vinh Sam private company (DNTN Vinh Sâm)	Domestic and foreign markets
5	Thanh Son private company (DNTN Thanh sơn)	US market
6	Muoi Sum private company (DNTN Mười Sum)	Domestic market
7	Hong Ngoc private company (DNTN Hồng Ngọc)	US market
8	Hong Cac private company (DNTN Hồng Các)	Domestic market
9	Nguyễn Dương (individual)	Domestic market
10	Nguyễn Văn Khoa (individual)	Domestic market

4.3 Boatyards

There are twelve boatyards in Phu Yen in 2012. Table 8 shows the list of these boatyards, their addresses and their boats.

Table 8. List of boatyards in Phu Yen province in 2012
Source: (Nhan, 2012)

TT	Owner of boatyards	Address	Note
1	Thanh Son private company	KP6, Phú Đông Ward, Tuy Hòa city	Build and repair tuna longline boats and purse seine boats
2	Nguyễn Tri	KP6, Phú Đông Ward, Tuy Hòa city	Build and repair tuna longline boats and purse seine boats
3	Huỳnh Đức Sỹ	KP6, Phú Đông Ward, Tuy Hòa city	Build and repair tuna longline boats and purse seine boats
4	Lê Thế Hưng	KP6, Phú Đông Ward, Tuy Hòa city	Build and repair tuna longline boats and purse seine boats
5	Trần Thai	KP6, Phú Đông Ward, Tuy Hòa city	Build and repair tuna longline boats and purse seine boats

6	Lương Chàng	KP6, Phú Đông Ward, Tuy Hòa city	Build and repair tuna longline boats and purse seine boats
7	Lương Luận	KP6, Phú Đông Ward, Tuy Hòa city	Build and repair tuna longline boats and purse seine boats
8	Lương Thanh Phong	KP6, Phú Đông Ward, Tuy Hòa city	Build and repair tuna longline boats and purse seine boats
9	Võ Văn Tuấn	Phước Hậu village, Xuân Đài Ward, Sông Cầu town	Build and repair trawl boats, gillnet boats and purse seine boats
10	Phạm Văn Phi	Phú Lương village, An Ninh Đông commune, Tuy An district	Build and repair trawl boats and gillnet boats
11	Bùi Văn Xếp	Phú Lương village, An Ninh Đông commune, Tuy An district	Build and repair trawl boats and gillnet boats
12	Trần Hữu Lợi	Phú Lương village, An Ninh Đông commune, Tuy An district	Build and repair trawl boats and gillnet boats

5. Tuna Fisheries management

5.1 Organization structure

The organizational chart for fisheries management in Phu Yen is shown in Figure 22. The Department of Agriculture and Rural Development (DARD) is a unit under Phu Yen People's Committee (PPC). Phu Yen Sub-DECAFIREP (provicial Department of Capure Fisheries and Resources Protection) is a unit under DARD and its duty is directly to manage fishing sector in the province. There are 3 field stations under sub-DECAFIREP situated in 3 Dong Hoa, Tuy An and Song Cau districts. Fisheries Division is the unit under DARD which act as an advisor for the DARD in management and operation of fishery.

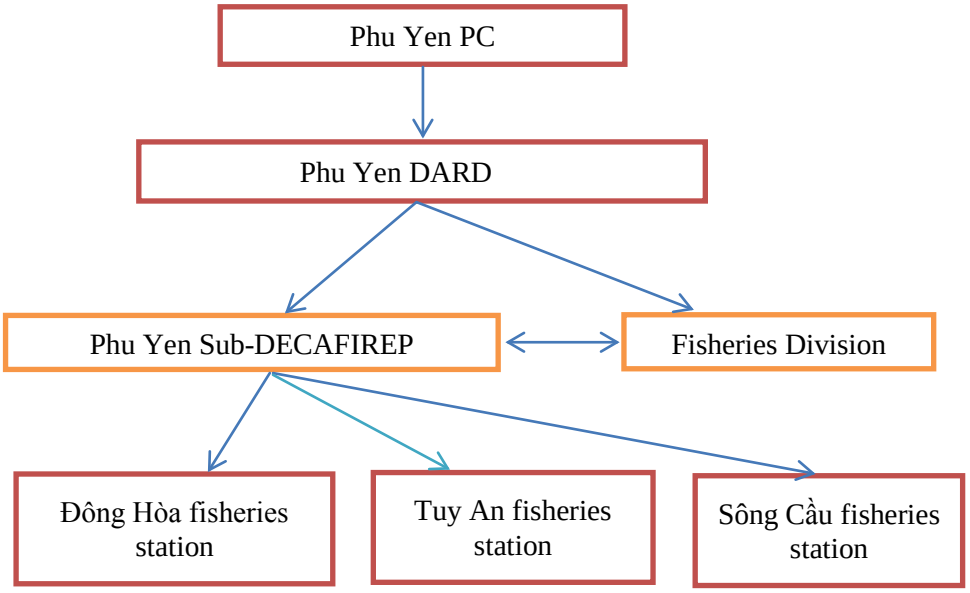

Figure 23. The organizational chart for fisheries management in Phu Yen
(Nhan, 2012)

5.2 Legal framework

National legal framework has been applied for tuna fisheries. In addition, Phu Yen PPC also issued the Decision No. 1144/2011/QĐ-UBND dated 25/7/2011 promulgating the Regulation on management of communication system for fishers, disaster prevention, response and mitigation for fishing boats and fishers in Phu Yen Province. Therefore, fishers have to be equipped all required communication equipments and the relevant user manuals of these equipments.

To create the favorable condition for fishermen going to the sea, Phu Yen PPC has approved the list of 473 boats with engine power of above 90 HP registering for offshore fishing in 2011 to have support according to the Decision No 48/2010/QD-TTg of the Prime Minister, accordingly, each boat depending on its engine power, will be equipped communication equipment. Recently, 169 offshore fishing boats have been approved in the first stage and supported 4.5 billion VND, it is now considering to approve the second stage for 96 boats with the budget about 2.5 billion VND

Besides the above development policies, the province also issues a series of related policies such as: fishery logistic service, recently, the project "building Phu Yen Fishery Logistic Service Center in Tuy Hoa City" has been approved with the total estimated budget of about 200 billion VND; regarding the market development, it is agreed to establish a Fish Trading and Processing Join Venture Company to purchase, process and export tuna. The Provincial Tuna Association in support of the Government and Ministry of Industry and Trade to develop the trademark for ocean tuna of Phu Yen.

5.3 Data collection

Logbooks and catch data have been collected by four staff from Sub-DECAFIREP in cooperation with four border defense stations (located in tuna fisheries districts). In total, 1250 logbooks, 690 biological samples, and 1639 tuna catch samples have been collected. Biological samples include 546 longline tuna samples, 113 purse seine samples, and 311 gillnet samples. Tuna catch sample include 1325 tuna longline samples, 256 purse seine samples, and 56 gillnet samples.

Chapter 4. Khanh Hoa's Tuna Fisheries Profile

1. Introduction

In 2011, there were 8,941 fishing boats with about 30,000 fishers in Khanh Hoa province, in which, there were 352 tuna fishing boats, accounted for 3.9%. Longline, gillnet and pure seine with average engine power of from 90 HP are three main fishing gears for tuna fisheries. In 2011, there were 99 tuna longline boats, 227 tuna gillnet boats and 26 tuna purse seine boats in Khanh Hoa province. Tuna longline and tuna gillnet boats are mainly in Nha Trang city. Tuna purse seine boats do not often operate in Khanh Hoa's sea waters. Some of purse seine boats have switched to purse seine with light catching for small pelagic fishes. In 2011, the total tuna production for yellowfin and bigeye tuna (by longline) was about 1,950 mt, and total skipjack tuna production was about 11,000 mt (by purse seine and gillnet) in 2011.

Although marine capture fishery in general and marine capture fishery in Khanh Hoa in particular has achieved significant steps in development compared to previous periods, some limitations are being existed in infrastructures, fishing techology, processing and trade. Therefore, analysis, assessment the overiew of tuna fishery in Khanh Hoa aiming to propose orientations, mechanisms, policies to develope the sustainable fishery in the furture is neccessary.

2. Background information

Khanh Hoa is located in the south central area, latitude of $11^0$50'00"N to $12^0$54'00"N, 5,258 km^2 of natural area, with above 520 km coastaline and 135 km border of islands. The eatern border of Khanh Hoa is the same eastern border of the nation, therefore, it is advantage condition for development of capture fishery especially for offshore fishing operations.

Khanh Hoa has totally more than 200 islands. Among 32 coastal islands, there are 19 islands of more than 0.05 km^2 with total area of about 49 km^2. The largest coatal island is Hon Tre with area of 36km^2, Hon Mieu, Hon Tam and Hon Mun have area of above 1 km^2 each. Among 70 islands located in the bay area, 26 island have area of more than 0.05 km^2 each and the biggest one is Hon Ro island, belonging to Van Phong – Ben Goi bay, has area of 44 km^2.

Khanh Hoa has also many large peninsulas such as Hon Heo with area of 146 km^2, Cam Ranh of 1106 km^2 and Hon Gom of 83 km^2. Khanh Hoa province has bays and large lagoons including Van Phong – Ben Goi bay with area of 503 kkm2, water depth of 30 m, Nha Trang bay of 249 km^2 with water depth of below 16 m and Cam Ranh bay has area of 185km and water depth of below 25 m.

Spilling to the sea, Khanh Hoa has several tens of small and short rivers and streams. The two rivers which have biggest valley in the province are Cai river in Nha trang with water ouput of 1,800 km^2 and Dinh river in Ninh Hoa has valley of 800 km^2. Total valley of rivers and streams in Khanh Hoa is approximately 3000 km^2. Natural conditions provide Khanh Hoa an area of 1000 ha of water reservoir for irrigation and aquaculture purpouses.

Khanh Hoa belongs to the typical wet tropical area, humidity of 70 – 80%, annual average rainfall of 1,300 – 1,700 m, yearly average temperature of 26.4^{o}C. Common trend, the high temperature season occurs during May – Septemeber and low temperature does during December to February of the following year. There is no clearly winter season in Khanh Hoa, normally in a year round there are two

seasons namely dry season and raining season, the dry season lasts from January to August and raining season coccurs from September to December, during the raining season the total rainfall is about 1000 mm.

The maximum average of surfacew seawater in Khanh Hoa is 31,3^{o}C and the minium is 23,4^{o}C, maximum salinity of 35,82‰ and the minimum of 30,11‰. In the lagoon area, during the dry season the salinity can be reached 41‰ and dropped to 1‰ during the raining season.

Figure 24. The map of Khanh Hoa Province

Box 3. General information about Khanh Hoa province in 2011 (GSO, 2012)

Location: ***South Central Coast Region;***
Area: ***5,217.6 km^2;***
Population: ***1.17 million;***
Monthly Average Income per Capita (2010):***1258 thousand VND (~65 USD);***
Marine Fishery Production: ***68.7 thousand MT (4% of the whole country);***
Number of offshore fishing vessels: ***728(2.6% of the whole country);***
Total capacity of offshore vessels: ***84.3 thousand HP (1.6% of the whole country)***
Gross Output of fishing: ***881.5 billion VND (1.5% of the whole country).***

3. Tuna fisheries

3.1 Tuna fleet

There are three main fishing gear types for tuna fisheries in Khanh Hoa province namely longline, gillnet and pure seine with average engine power of higher or equal 90 HP. In 2011, there were 99 tuna longline boats, 227 tuna gillnet boats and 26 tuna purse seine boats in Khanh Hoa province (Table 9). Tuna longline and gillnet boats are mainly in Nha Trang city. Tuna purse seine boats do not often operate in Khanh Hoa's sea waters. Some of purse seine boats have switched to purse seine with light catching for small pelagic fishes.

Table 9. Structure of tuna fleet in Khanh Hoa
(RIMF, 2011)

Gear	Local	HP group (HP)				Total
		90 - 150	150 - 250	250 - 400	≥400	
Longline	Nha Trang	27	29	40	3	**99**
Gillnet	Nha Trang	35	34	100	29	**198**
	Cam Ranh	5	6	6	1	**18**
	Ninh Hòa	2		1	1	**4**
	Vạn Ninh	2	4	1		**7**
Purse seine	Nha Trang	1	1	3	1	**6**
	Cam Ranh	5	4			**9**
	Ninh Hòa	0	1			**1**
	Vạn Ninh	5	4	1		**10**
Total		**82**	**83**	**152**	**35**	**352**

3.2 Tuna cach

3.2.1 Tuna catch estimates

WPEA OFM Project conducted tuna catch estimation workshop in November 2012, and provided the total tuna production for yellowfin and bigeye tuna (by longline) as about 1,950 mt, and total skipjack tuna production as about 11,000 mt (by purse seine and gillnet) in 2011.

3.2.2 Catch rate

Catch rate data is currently not available for tuna fisheries in Khanh Hoa province.

3.2.3 Catch composition

Figure 25 shows tuna catch composition of tuna longline and tuna gillnet boats in Khanh Hoa from 2010 to 2012. Skipjack tuna were dominant and accounted for 70% in catches of tuna gillnet boats. Yellowfin and bigeye tuna accounted for 55% and 45% in catches of tuna longline boats respectively.

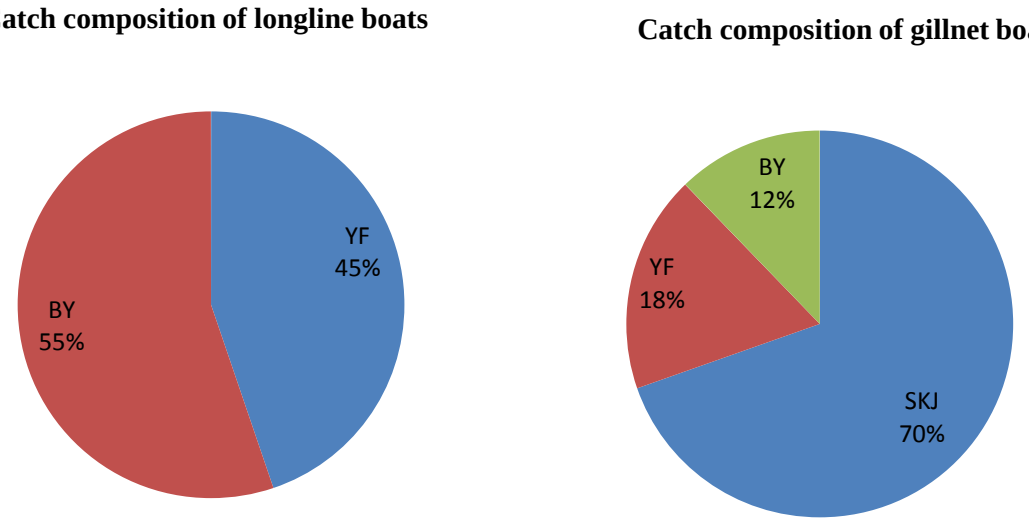

Figure 25. Catch composition of tuna fisheries in Khanh Hoa
Source: (data from WPEA OFM Project, 2012)

3.3 Tuna fisheries labor

In Khanh Hoa province, there are about 10 fishers working at each tuna longline/handline, purse seine and gillnet fishing boat and there are around 352 (engines of higher than 90 HP, offshore operation) fishing vessels for such fisheries in 2012. So total fishing labors can be estimated as 3520 fishers employed in tuna fishery (personal communication with Khanh Hoa Sub-DECAFIREP office).

3.4 Tuna trade and consumption

Figure 26 shows tuna trade and consumption in Khanh Hoa province. There are three steps for the trading procedure:

Step 1: middlemen collect fish from fishers and transfer to the relevant seafood processing and exporting companies which have deals.

Step 2: Seafood processing and export companies will transport good quality fish for whole individual exporting purpose to oversea counterparts. The rest will be exported under fillet or smoked items.

Step **3:** fish (fresh, whole) will be sell at auction markets (in Japanese market) or distribute to consumers (US market) by the oversea companies. Some companies buy directlt fish from fishers and export (very popular in Khanh Hoa province).

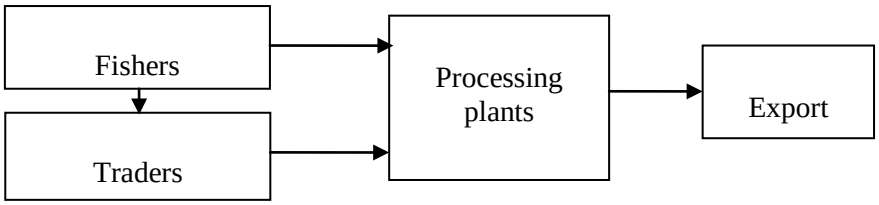

Figure 26. Tuna trade and consumption in Khanh Hoa province

Currently the amount of total tuna export is 83,863 mt but breakdown of the export into provincial level is not available.

4. Fisheries Infrastructure

4.1 Tuna fishing harbor

There are 6 fishing harbors in Khanh Hoa province: Hòn rớ, Vĩnh Trường, Đá Bạc, Vĩnh Lương, Đại Lãnh, Cam Bình. The aggregate technical characteristics of the fishing harbors are described as follows:

- The total length: 650m
- Total capacity for landing: 4,000 fishing boats up to1,000 HP
- Total area: 46.500m^2, in which area for landing is 5.600m^2.

Figure 27. Hon Ro fishing harbor in Khanh Hoa province
(photos taken by Nguyen Van Dau in 2012)

4.2 Processing plants

There are 1,493 tuna traders in Khanh Hoa province. The seven biggest tuna traders are listed in Table 10.

Table 10. List of tuna traders in Khanh Hoa province
Source: (Dau, 2012)

No	Name of traders	Address
1	Ben Vung limited company (Công ty TNHH Bền Vững)	Suoi Dau industrial zone
2	Hoang Long Nhi limited company (Công ty TNHH Hoàng Long Nhị)	Hòn Rớ
3	Hai Vuong limited company (Công ty TNHH Hải Vương)	Suoi Dau industrial zone
4	Tin Thinh limited company (Công ty TNHH Tín Thịnh)	Suoi Dau industrial zone
5	Thinh Hung limited company (Công ty TNHH Thịnh Hưng)	KCN Suối Dầu
6	Diep tac tuna trader (Cơ Sở Diệp Tác)	Hòn Rớ
7	Hai Duong tuna trader (Cơ sở Hai Đuộng)	Vĩnh Phước

4.3 Boatyards

There are 11 boatyards with capacity of building 50 new boats and repairing 45,000 boats per year. Two boatyards can build composite boats.

5. Tuna Fisheries management

5.1 Organization structure

The provincial Departement of Capture Fisheries and Resource Protection (sub-DECAFIREP) in Khanh Hoa under Department of Agriculture and Rural Development (DARD), has mandate to directly manage fishing operations in Khanh Hoa. In 2012, totally, Sub-DECAFIREP has 27 staff, experts and contract labours and 60 voluntary persons. Presently, the su-DECFIREP in Khanh Hoa has 3 field stations namely:

- Station of Capture Fisheries and Resources Protection Cam Ranh – Khanh Son – Truong Sa.
- Station of Capture Fisheries and Resources Protection Van Ninh.
- Station of Capture Fisheries and Resources Protection Ninh Hoa.

At head office of Sub-DECAFIREP, there are three divisions as follows:

- Division of Administration: has duty to compile reports, data from relevant specialization divisions,develop advisory reports to DARD and PPC for operating fisheries sector.
- Division of Capture fishery, Fisheries resources and Aquatic environment Management has mandate to manage issues related to capture fishery, aquatic resources and environment protection.
- Division of fishing vessels and fisheries logistics management: implement monitoring fishing vessel registration, technically safety inspection and activities related to fisheries logistics.

5.2 Legal framework

Together with others provinces in the country, Khanh Hoa province well implemented support policy for fishers through out implementation of Decision Khanh Hoa's PPC has just approved master plan of fisheries sector in the province to 2015 and vision to 2020. In which, fishery is considered as a key economics sector in the ongoing years of the province. Purpose of the plan is to organize, manage and exploit the available potentials for developing sustainable fisheries sector togetther with other economics sectors in the province, promote development of socio-economics, generate opportunities for jobs, improvement of incomes not only for improving living standards of fishers but also inhabitants in areas which are related to fisheries sector. Instantaneously, develop stable, sustainable fisheries sector for present and future time based on promoting development growth of people fishery following directions of coupling effectiveness with environement protection, mordenization and industrialization aiming to develope economics system of goods production which have adequate competitiveness in domestic and global markets. According the plan, in near future, the province will mobilize all resources in all economics sectors together with the government to invesnt in fisheries development in 4 areas: capture fishery, aquaculture, processing and export. Besides, the fisheries sector will be approached morden technology, in which aquaculture and processing are prioritized for increasing value added items for export. In parrallel, connecting capture fishery with security and defense issues to creat premises for fisheries sector in Khanh Hoa to be come strong economics sector in all areas including capture fishery, aquaculture, processing, logistics and export.

5.3 Data collection

Data collection program has been implemented since October 2010. Tuna fisheries data has been collected in Hon Ro fishing harbor. In total, 2240 catch samples and 619 biological samples have been collected.

Chapter 5. Conclusion

Vietnamese tuna fisheries have developed rapidly in recent years. The tuna export value raised over ten times from 22.98 million US$ in 2000 to approximately 379.4 million US$, accounted for about 6.9% of the total estimated delivered value of the WCPO tuna catch in 2011. Main fishing gears for tuna fisheries in Vietnam are longline, purse seine, and gillnet. The longline tuna fishery appears only in the three central provinces of Vietnam (Khanh Hoa, Binh Dinh, and Phu Yen) and its main targeted species are bigeye and yellowfin tuna. The gillnet and purse seine fisheries appear in almost all central coastal provinces and their catches are mainly skipjack tuna.

There are some issues related to management of tuna fisheries that need to be considered. Firstly, government policy is to ease the pressure on coastal resources and to further develop the industry (economic growth strategy) through better utilization of deep-sea resources. The government has embarked on a program to shift focus from inshore to offshore fishing by increasing incentives, such as loans and grants, to enable fishermen to shift their production away from inshore fishing. Oceanic tuna species are offshore target species which have been encouraged to exploit due to their high export values. Secondly, Vietnamese marine fisheries are regulated according to the size of the boat engine and the location of fishing activity. Boat operators should obtain marine fishing licenses depending on their operation zones, the size of the boat engine, the gear type employed as well as other conditions. The fee levied is proportional to the engine size of the boat. The procedure for license applications is widely considered to be relatively straightforward, and a license application generally leads to a license being granted. In this case, tuna fisheries in Vietnam can be viewed to be in ‘open access’ situation, therefore, more effort could be attractive to the fisheries. Those are potential threats that could lead the tuna fisheries to be overexploited and a depletion of the tuna stocks in the near future. A reasonable management plan should be developed and implemented to conserve tuna stocks as soon as possible.

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Annex 1.
Research projects on tuna stocks and tuna fisheries in Vietnam

Research projects on tuna stocks and tuna fisheries in Vietnam are described as follows:

(1) Viet-Russia cooperative research in 1960, the first time, tunas were researched by using research boats Viet – Russia. Main research area was the Gulf of Tokin and some researches were implemented in the south of the gulf.

(2) From 1991 to 1993, a project KN04-01 focused on study tuna fisheries resources in the Gulf of Tonkin and the central area of Vietnam. Project provided some results on biological characteristics of tunas including frigate tuna (*Auxis tharzard*), kawakawa (*Euthynnus affinis*), longtail tuna (*Thunnus tonggol*), bullet tuna (*Auxis rochei*) in the researched areas and a Atlas of tuna in Vietnam with 8 tunas species decribed and their biological characteristics.

(3) During 1994 – 1997, project "Study on marine aquatic resources in the Spatly Archipelago" had studied general aquatic resources in the south and west of Spratly Archipelago. Additionally, the project provided results on biology, catch rate, catch of some main species caught such as skipjack tuna. However, due to limitation in study scope and activity, the study achieved some limited results.

(4) During 1996 – 1997, project "Assesment of the living marine resources in Vietnam" supported by JICA (Japan) used gillnet to survey oceanic pelagic fishes (tunas, rays…) in offshore waters from Đồng Hới to Cà Mau. Results have identified species composition and catch distribution of some popular tuna species in the two monsoon, northeast and southwest monsoons.

(5) During 2000 – 2005, project "Assessment of the Living Marine Resources in Vietnam – ALMRV phase II" used gillnet, longline for stock assessment of pelagic fishes in the central and southeas waters of Vietnam. The project had provided some results on characteristics of biology and distribution of skipjack tuna and bullet tuna…

(6) Some other projects which studied on tunas such as: project "Survey on marine fisheries resources for developing offshore fishery" during 1998 – 1999; Project "Study, survey marine fisheries resources and select suitable fishing technology for developing offshore fishery in Vietnam" during 2000 – 2002; project "Develop model for capture fishery and structure of oceanography related to offshore fishery in Vietnam during 2001 – 2004". The above projects basically identified main fished species in offshore waters by gears; studied on biological characteristics of these species.

(7) During 2002 – 2004, project "Study on stock biomass and allowable catch of pelagic fishes (mainly skipjact tuna, yellowfin and big eye tunas) and current status of fishing effort structure in offshore waters in the Central and Southeast areas" had more studies on tuna fish stock assessment, premilinary assess resource of skipjack tuna, yellow fin and big eye tunas in offshore waters in the Cental and Southeast areas.

(8) During 2005 – 2006, RIMF had succed in implementation of the project "Study on improvement and use new technology in oceanic tuna longline fishery in the central and southeast areas". Results of the project have proposed improvement for longline for fishers in Phu Yen province.

(9) During 2008 – 2011, RIMF collaborated with WWF to implement trials of circle hooks in tuna longline. Results showed a assessment of effectiveness use of circle hooks and mitigation of sea turtle hooked. These results created a scientific base for introducing circle hooks to tuna longline fishery.

(10) During 2010 – 2011, the Western and Central Pacific Commission (WCPFC) collaborated with some organizations, agencies in Vietnam to conduct survey, monitor and collect information of tuna longline in Vietnam aiming to generate basis for helping Vietnam graduadly to be member of WCPFC. Currently, activities carried out by WCPFC in Vietnam are being implemented and prelinirary results have been achieved and provided some present considerations in Vietnam tuna longline fishery.