ENERGY SAVING MEASURES AND RATIONAL ENERGY CONSUMPTION IN FISHING INDUSTRY

Mga Panukala sa Pagtitipid ng Enerhiya at Makatuwirang Paggamit ng Enerhiya sa Industriya ng Pangisdaan

(For Philippines)

SEAFDEC

JTF
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Southeast Asian Fisheries Development Center

What is SEAFDEC?

The Southeast Asian Fisheries Development Center (SEAFDEC) is an autonomous intergovernmental body established as a regional treaty organization in 1967 to promote fisheries development in Southeast Asia.

Objectives

SEAFDEC aims specifically to develop the fishery potential in the region through training, research and information services in order to improve the food supply by rational utilization of the fisheries resources in the region.

Functions

To achieve its objectives, the Center has the following functions:

1. To offer training courses, and organize workshops and seminars in fishing technology, marine engineering, extension methodology, post-harvest technology, and aquaculture.

2. To conduct research on fishing gear technology, fishing ground survey, post-harvest technology and aquaculture, to examine problems related to the handling of fish at sea and quality control, and to undertake studies on the fishery resources in the region.

3. To facilitate the transfer of technology to the countries in the region and to provide information materials to the print and non-print media, including the publication of statistical bulletins and reports for the dissemination of survey, research and other data on fisheries and aquaculture.

Membership

SEAFDEC membership is open to all Southeast Asian Countries. The Member Countries of SEAFDEC at present are Brunei Darussalam, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

Ano ang SEAFDEC?

Ang Southeast Asian Fisheries Development Center (SEAFDEC) ay isang may kasarinlang ahensiya ng pinagsama-samang mga pamahalaan ng mga bansa na itinatag bilang isang pan-rehiyong kasunduang organisasyon noong 1967 upang magsulong ng kaunlarang pampangisdaan sa Timog-Silangang Asya.

Mga Layunin

Ang SEAFDEC ay naglalayong paunlarin ang kakayahang pampangisdaan sa rehiyon sa pamamagitan ng pagsasanay, pananaliksik at serbisyong kaalaman upang mapabuti ang pagtustos ng pagkain sa pamamagitan ng makatuwirang paggamit ng yamang-pangisdaan sa rehiyon..

Mga Tungkulin

Upang makamit ang mga layunin nito, ang Center ay may mga sumusunod na tungkulin:

1. Upang mag-alok ng mga kurso sa pagsasanay, at maghanda ng mga sama-samang pag-aaral at seminar sa teknolohiya ng pangingisda, "marine engineering", pamamaraan sa tamang paggabay, teknolohiya ng mga gawain pagkatapos ng pagkahuli sa isda, at pag-aalaga ng isda.

2. Upang magsagawa ng pananaliksik sa teknolohiya ng gamit-pangisda, pagsisiyasat sa lugar-pangisdaan, teknolohiya ng mga gawain pagkatapos ng pagkahuli sa isda, at pag-aalaga ng isda, upang suriin ang mga problema na may kaugnayan sa pangangasiwa ng isda sa dagat at pagkontrol ng kalidad, at upang idaos ang pag-aaral sa mga yamang-pangisdaan sa rehiyon.

3. Upang pangasiwaan ang paglipat ng teknolohiya sa mga bansa sa rehiyon at upang magbigay mga gamit-pangkaalaman sa mga lathalain at di-nilalathalang *media*, kabilang ang mga lathalain ng mga istatistikang *bulletin* at mga ulat para sa pagpapakalat ng pagsisiyasat, pananaliksik at iba pang mga datos sa pangisdaan at pag-aalaga ng isda.

Kasapian

Ang pagiging miyembro sa SEAFDEC ay bukas sa lahat ng mga bansa sa Timog-Silangang Asya. Ang mga bansang miyembro ng SEAFDEC sa kasalukuyan ay Brunei Darussalam, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, Pilipinas, Singapore, Thailand, at Vietnam.

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Ang paglimbag ng lathalaing ito ay sa pamamagitan ng Japanese Trust Fund para sa SEAFDEC.

Introduction

The oil prices have soared worldwide over the year before last to last summer due to the rush for oil caused by economic development of emerging countries such as China and India, the political uncertainty of oil producing countries and the inflow of speculative money and the "Arabian light crude" which is index of crude in Asia including Japan, has set a record high of $139.72/barrel as of July 14th last year. Subsequently, the oil prices has dropped sharply with the world economy shrinking rapidly due to the financial crisis from the end of last year, and as of March 16th this year it priced $41.28 per barrel. However, considering the price trends over the past 30 years, the oil prices have still been high and it is expected that in the near future the demand for oil will go up due to the economic recovery. In addition to the aspects mentioned above, the price drop in crude will slow down the development of oilfield and another concern following this is the skyrocketing crude oil price. Steep rise in the price of crude oil has a grave impact on fishing industry. Above all, the cost of fuel in f capture fishery accounts for a large percentage of its cost, and due to the trends of consumers and the retail industries, it is not easy to pass the higher cost along to them. The percentage of fuel cost in the cost of production of the capture fishery accounted for 10-20 % until 2004, however in 2005 it accounted for over 20%, and this year at the fuel oil price peak, the percentage of fuel cost of deep-sea fishing, adjacent fishing of skipjack and tuna and squids-fishing fishing accounted for over 40%. Therefore, curbing consumption on fuel cost is a significant challenge from a business standpoint. Furthermore, it is necessary to revise the energy consumption structure of fishing industry, and also to make shift to energy saving industry which is not influenced by fuel price for the purpose of being able to respond to the future global environment problems and also to develop and maintain as a sustainable marine industry. Therefore, we "The Fisheries Research Agency "(hereinafter referred to as the "FRA") have established the Research Committee of Saving Energy Technology in Fishing Industry (hereinafter referred to as the "Research Institute") consisting of academic experts with a goal of considering the current condition of energy saving technology in the fishing industry including capture fishery and the desirable future direction of energy consumption. The Research Institute has formed 3 research groups "Rationalization of energy utilization", "LED introduction propulsion research" and "proper temperature management setting of fishery products" and has studied issues regarding the current condition and utilization of research and development of energy saving technology. In addition to that, the institute has made pamphlets towards the fisheries which explain the specific technical content and also has begun the process of figuring out the amount of carbon dioxide emissions which will become a basis for the future fishery in our country to be able to utilize the energy reasonably and effectively. This report compiles proposals for future efforts towards energy saving in the fishing industry as well as the result of studies from each research group.

March 18th, 2009

Fisheries Energy Technology Research Institute　Chairperson　Kiyoshi Inoue

Pangunahing Salaysay

Ang presyo ng langis ay tumaas sa buong mundo sa mga nakaraang taon dahil sa pangangailangan sa langis dulot ng pag-unlad ng ekonomiya ng mga umuusbong na bansa gaya ng *China* at *India*, ang pag-aalinlangang- pampulitikal ng mga bansang pinanggagalingan ng langis at ang pagpasok ng *speculative money* at ng *Arabian light crude* na naging batayan ng presyo ng langis sa Asya, kabilang na ang *Japan*, kung kaya nakapagtala ng mataas na marka na umabot sa $139.72/bariles noong Hulyo ng nakaraang taon. Kasunod nito, ang presyo ng langis ay bumulusok kaalinsabay ng mabilis na pag-urong ng pandaigdigang ekonomiya dulot ng krisis ng pananalapi mula sa huling bahagi ng nakaraang taon, at mula ika-16 ng Marso ng taong kasalukuyan ay pumalo ang presyo sa $41.28 bawat bariles. Gayunpaman, inaasahang patuloy na tataas ang pangangailangan sa langis sa hinaharap, base na rin sa naging takbo ng presyo sa nakaraang 30 taon dahil sa pagbawi ng ekonomiya. Dagdag pa rito, ang pagbagsak ng presyo ng langis sa kasalukuyan ay magpapabagal sa paggawa ng *oilfield* at magbubunga sa mabilis na pagtaas ng presyo ng langis sa hinaharap. Ang biglaang pagtaas ng presyo ng langis ay may malaking epekto sa industriya ng pangisdaan. Ang halaga ng langis ay kumakatawan sa malaking porsiyento sa gastusin sa pangingisda, at dahil sa takbo ng mga mamimili at namamahagi, hindi madaling ipasa ang dagdag na halaga sa mga mamimili. Kumatawan sa 10-20 % ng halaga ng produksiyon sa pangingisda ang halaga ng langis hanggang 2004, subalit noong 2005 ay kumatawan ng higit sa 20%. Sa taong ito, kung saan naitala ang pinakamataas na presyo, ang porsiyento ng halaga ng langis sa pangingisda sa malalim na karagatan(*deep-sea fishing*), malapitang pangingisda (*adjacent fishing*) ng tambakol at tuna at pangingisda ng pusit ay umabot sa higit 40%. Sa makatuwid, ang pagtitipid ng langis-panggatong ay malaking hamon sa punto ng mga namumuhunan. Bukod dito, kinakailangang baguhin ang lagay ng pagkonsumo ng langis sa industriya ng pangisdaan at tumungo sa industriyang matipid sa enerhiya at hindi masyadong naaapektuhan ng presyo ng langis upang makatugon sa pandaigdigang suliranin sa kapaligiran at makagawa ng sustenableng industriya sa karagatan. Sa makatuwid, kami na *Fisheries Research Agency* (na binansagang *FRA*) ay nagtatag ng *Research Committee* sa Teknolohiya sa Pagtitipid ng Enerhiya sa Industriya ng Pangisdaan (na binansagang *Research Institute*) na binubuo ng mga bihasa sa larangan ng pananaliksik na naglalayong pag-aralan ang kasalukuyang antas ng teknolohiyang nauukol sa pagtitipid ng enerhiya sa industriya ng pangisdaan at ang tatahaking landas sa hinaharap ukol sa paggamit ng enerhiya. Ang naturang *Research Institute* ay bumuo ng 3 grupo ng pagsasaliksik: *Rationalization of Energy Utilization, LED Introduction Propulsion Research* at *Proper Temperature Management Setting of Fishery Products* at sumuri sa mga isyung nauukol sa kasalukuyang antas ng pananaliksik tungkol sa teknolohiya ng pagtitipid sa enerhiya. Dagdag pa rito, ang ahensiya ay gumawa ng mga polyeto na nagpapaliwanag sa mga teknikal na nilalaman at nagsimulang pag-aralan ang dami ng *carbon dioxide emissions* upang makagawa ng basehan tungo sa matipid na paggamit ng enerhiya sa industriya ng pangisdaan sa ating bansa. Ang ulat na ito ay naglalakip ng mga mungkahi na maaring tahakin sa hinaharap tungo sa pagtitipid ng enerhiya sa industriya ng pangisdaan kabilang na ang bunga ng mga pagsasaliksik na ginawa ng bawat grupo.

Ika-18 ng Marso, 2009

Fisheries Energy Technology Research Institute Chairperson Kiyoshi Inoue

I. Current condition of energy consumption of fishing vessels

In the capture fishery, except for the gasoline used in outboard engine, most of the deep-sea and offshore fishing vessels use fuel oil A and as for coastal fishing vessels they use fuel oil A and light oil. In 2008 according to the study on global warming countermeasures in the field of agriculture, forestry and fisheries of the project to promote environment biomass (Ministry of Agriculture, Forestry and Fisheries of Japan), fuel consumption of the capture fishery in our country in 2005(except for gasoline, total amount of light oil and fuel oil A) is 2,160,000 kl-2,450, 000 kl. According to the annual statistics of resources and energy, the volume of sales of light oil in our country in 2005 was 42,180,000 kl, and that of fuel oil A was 35,000,000 kl. Therefore, fuel consumption of capture fishery accounts for 2.8%-3.2% of the total amount of the sales volume of fuel oil A and light oil.

Reflecting considerable reduction in the number of medium and large scale deep-sea and offshore fishing vessels, and fishery employees due to the aging of fishery employees and the downturn in the price of fish, fuel consumption of fishing vessels have continued to decrease every year. However, considering that the amount of gross domestic product in our country is 503,200,000,000,000 yen and the gross product of the fishing industry is 880,000,000,000 yen (the amount which is calculated on a product basis by economic calculation of Agriculture and Food related industry), therefore considering that the fishing industry accounts for only 0.17%, it can be said that the fishing industry is a fuel intensive-industry compared to other industries.

II. Current condition of energy saving technology by fishing vessels

1. Visualization fuel consumption

When considering about energy saving of fishing vessels, it is fundamental to first know the amount of fuel consumption of fishing vessels. Fishing vessels require complicated operational techniques for the purpose of fish haul and it is completely different from merchant vessels of which purpose is to simply carry products and people. For the reason that prime power inboard may vary greatly depending on the condition of the operation, the fuel consumption of main engine and auxiliary engine also undergo significant fluctuation. It is expected that the vessel operator will be aware of fuel cost and will make efforts to operate thinking about energy saving by setting fuel flow gauge in the main engine and the auxiliary engine and display the result in the bridge and machinery control room on a real time basis.

In general, fuel flow gauge is set between fuel tank inside engine room and engine for both the main engine and auxiliary engine. In most engines, the amount of fuel oil sent to the engine by a pump is more than the amount of actual consumption, therefore some amount of oil return to fuel tank, therefore it is necessary to measure the flow volume both in the entrance and the exit of engine and calculate the difference as fuel consumption. Some of medium and large scale fishing vessels have flow devices which measures the fuel which pumps up from bottom tank to service tank, there are almost no fishing vessels which can display how much fuel is consumed on a real time basis, when the vessel is in operation. At this moment, flow gauge and display system which are easy to install to fishing vessels are not available, it is recommended the fuel flow gauge which is easy to install to fishing vessels will be developed in the future.

I. Kasalukuyang kalagayan ng paggamit ng enerhiya ng mga bankang pangisda

Sa pangingisda, maliban sa mga gumagamit ng gasolina sa bangkang de-motor, karamihan sa mga nangingisda sa malalim na bahagi ng karagatan (*deep-sea* at *off-shore*) ay gumagamit ng *fuel oil A* at sa mga pang-malapitang bankang-pangisda naman ay *fuel oil A* at *light oil*. Noong 2008, base sa pag-aaral na ginawa ng bansang *Japan* (*Ministry of Agriculture, Forestry and Fisheries*), umabot sa 2,160,000 kl – 2,450,000 kl ang nagamit na langis-panggatong para sa pangingisda sa ating bansa. Ayon sa taunang tala ng kayamanan at enerhiya, ang bilang ng naibentang *light oil* sa bansa noong 2005 ay 42,180,000 kl, samantalang umabot naman sa 35,000,000 kl ang sa *fuel oil A*. Sa makatuwid, ang paggamit ng langis-panggatong para sa pangingisda ay kumakatawan sa 2.8%-3.2% ng kabuuang bilang ng benta ng *fuel oil A* at *light oil*.

Patuloy na bumababa bawat taon ang paggamit ng langis-panggatong dulot na rin ng pagbaba ng bilang ng katamtaman (*medium*) at malalaking (*large-scale*) mga bankang pangisda, pagbaba ng bilang ng mga manggagawa dahil sa pagtanda, at pagbagsak ng presyo ng isda. Subalit masasabi pa rin na ang industriya ng pangisdaan ay mas malakas kumonsumo ng langis-panggatong kumpara sa iba pang mga industriya sapagkat ang kita mula sa pangingisda (880,000,000,000 yen) ay nasa 0.17% lamang ng kabuuang kita mula sa produksiyon ng ating bansa (503,200,000,000,000 yen).

II. Kasalukuyang kalagayan ng teknolohiya sa pagtitipid ng enerhiya ng mga bankang pangisda

1. Pagtanaw sa paggamit ng langis-panggatong

Mahalagang alamin ang dami ng ginagamit na langis-panggatong ng mga bankang pangisda kapag ang usapin ay tungkol sa pagtitipid ng enerhiya. Ang mga bangkang pangisda ay nagsasagawa ng maligalig na mga pamamaraan upang makahuli ng isda at ito ay lubhang naiiba sa pamamaraan ng mga bangkang ginagamit lamang sa paghahatid ng produkto at pasahero. Sa kadahilanang ang *prime power inboard* ay maaring mag-iba ayon sa paggamit, ang paggamit ng langis-panggatong ng pangunahin at pantulong na makina ay nagkakaiba ng malaki. Inaasahang sa kasalukuyan, ang gumagamit ng bangka ay may alam sa halaga ng langis-panggatong at magsasagawa ng pagtitipid sa pamamagitan ng paglalagay ng fuel flow gauge sa pangunahin at pantulong na makina na magpapakita ng resulta sa *bridge* at *machinery control room*.

Karaniwan, ang *fuel flow gauge* ay matatagpuan sa pagitan ng lalagyan ng langis-panggatong at ng makina. Madalas, ang dami ng langis-panggatong na pumapasok sa bomba ay mas madami kaysa sa kinakailangan. Sa makatuwid, ang sobra ay bumabalik sa lalagyan kung kaya't nararapat na sukatin ang pumapasok at lumalabas na langis-panggatong upang malaman ang dami ng konsumo. May ilang katamtaman at malalaking bangkang pangisda na may gamit-panukat ng konsumo subalit halos walang bangkang pangisda na may kakayahang makita ang konsumo habang tumatakbo. Ito ay sa kadahilanang walang kagamitang nakagagawa nito sa kasalukuyan at ito ang inaasahang maimbento sa hinaharap.

2. Trend of fuel consumption rate by fishing vessel engines

Diesel engines used in fishing vessels are superior in terms of thermal efficiency among practical internal-combustion engines. Since 1970s energy crisis, research and development toward energy saving has continued and there has been an effort to reduce fuel consumption rate.

However in 2005, global regulation against exhaust gas emission which is intended to reduce nitrogen oxide (NOx) for marine engines of which output are more than 130Kw was introduced, what's more second emission control will start in 2012 requiring more reduction of nitrogen oxide and continuously there will be third emission control following this second control. In order to reduce nitrogen oxide, it is necessary to lower combustion temperature which will also lead to a decrease in thermal efficiency. The key point of technical development is to pass the emission control which will be even more reinforced in the future without deteriorating fuel consumption rate.

3. Specific energy saving technology by fishing vessels

Here I would like to explain about current condition of energy saving technology which is applicable to existing fishing vessels as follows. (1)Energy saving by operational technique, (2)Energy saving technology by proper re-equipping of hulls, (3)Energy saving technology by proper conversion of engine (4)Energy saving technology using fishing gear (5)Energy saving technology which is available at the time of vessel construction (6)Energy saving technology to be considered for the future

(1) Energy saving by operational technique

1) Slowing down (Control of navigation speed)

This operational measure is applicable to all fishing vessels regardless of types of fisheries, size and hull forms. It needs output requiring propulsion which is approximately proportional to the cube of the speed of the vessels. Therefore, a slight decrease in speed will considerably reduce the output requiring propulsion and the fuel consumption will as well be reduced.

This rule is applicable to the offshore or deep-sea fishing vessels which are called displacement type of fishing vessels. The length of these vessels is over 20m in length and the navigation speed is less than 13 knot. Practically, slowing down the speed when navigating the same distance will decrease the fuel consumption with the square of the corresponded speed approximately and it is due to the fact that the time which navigating requires will increase in proportion to the corresponded speed.

On the other hand, most of the small size coastal fishing vessels are called semi-planing type fishing vessels with the length of less than 20m in length and the speed of over 14knot. Bow will be lifted up in case the speed is over 10 knot for these types of fishing vessels, when the vessel is in semi-planing condition. The rule of cube of the vessel's speed does not apply for these types of the vessels. In this speed range, fuel consumption in a fixed distance is proportional to the speed,

Slower speed will however, prolong the navigation time (days) which could increase fuel consumption of auxiliary engine in proportion to time and also influence the fish catch. Therefore it is necessary to take these matters into

2. Takbo sa paggamit ng langis-panggatong

Ang mga makinang pang-krudo na ginagamit sa mga bangkang pangisda ay nakahihigit sa alinmang makina sa larangan ng *thermal efficiency*. Simula noong krisis pang-enerhiya noong 1970, ang mga pagsasaliksik tungo sa pagtitipid ng enerhiya ay nagpatuloy at nagsikap na mapababa ang konsumo.

Subalit noong 2005, nagkaroon ng pandaigdigang panuntunan na naglalayong mabawasan ang *nitrogen oxide* (*NOx*) para sa makinang pandagat na may lakas na 130Kw. Sa darating na 2012, magsisimula ang ikalawang panuntunan na lalong maghihigpit sa pagbuga ng *nitrogen oxide* (*NOx*). Siguradong may mga susunod pang paghihigpit na darating. Upang mabawasan ang *nitrogen oxide*, kinakailangang ibaba ang *combustion temperature* na magreresulta sa pagbaba ng *thermal efficiency*. Ang susi ay makapasa sa *emission control* na magiging mas mahigpit sa hinaharap nang hindi naaapektuhan ang bilis ng konsumo.

3. Mga teknolohiya ng pagtitipid ng enerhiya sa mga bangkang pangisda

Ang mga sumusunod ay pagsasalarawan ng mga ibat-ibang kaparaanan sa pagtitipid ng enerhiya na maaring gamitin sa bangkang pangisda. (1)Pagtitipid ng enerhiya sa pamamagitan ng operasyon, (2) Pagtitipid ng enerhiya sa pamamagitan ng pagsasaayos ng katawan ng bangka, (3) Pagtitipid ng enerhiya sa pamamagitan ng pagpapabago ng makina (4) Pagtitipid ng enerhiya sa pamamagitan ng gamit-pangisda (5) Pagtitipid ng enerhiya sa pamamaraang akma habang ginagawa ang bangka (6) Pagtitipid ng enerhiya sa hinaharap

(1) Pagtitipid ng enerhiya sa pamamagitan ng operasyon

1) Pangangasiwa sa bilis ng paglalayag

Ang pamamaraang ito ay maaring gamitin sa lahat ng uri ng bangkang pangisda. Ito ay nangangailangan ng salida na halos katapat ng *cube* ng bilis ng bangka. Sa makatuwid, ang bahagyang pagbagal ng salida ay siya namang ikatitipid ng konsumo.

Ang panuntunang ito ay sumasaklaw sa mga *off-shore* o pang-malayuang bangkang pangisda na tinaguriang *displacement type*. Ang haba ng ganitong mga bangka ay higit 20m at tumatakbo sa bilis na mas mababa kaysa sa 13 *knot*. Ang mas mabagal na paglakbay sa pagtawid ng katulad na layo ay magdudulot ng mas matipid na konsumo sapagkat ang tagal ng paglalakbay ay nakakawing sa bilis ng paglalayag.

Sa kabilang banda, ang mga maliliit na bangkang pangisda ay tinatawag na *semi-planing* at nagtataglay ng habang hindi lalampas ng 20m at bilis na hindi hihigit sa 14 *knot*. Ang unahan ng bangka ay aangat kapag lumampas sa bilis na 10 *knot* habang ito ay nasa *semi-planing* na pagtakbo. Ang panuntunan ng *cube* ng bilis ng bangka ay hindi maaring gamitin sa ganitong klase ng mga bangka. Sa ganitong larangan ng bilis, ang konsumo sa nakatakdang layo ng tatakbuhin ay proporsyonal sa bilis.

Ang mas mabagal na pagtakbo ay magpapatagal sa paglalakbay na maaring magpataas ng konsumo at maaaring makapekto sa dami ng huling isda. Sa makatuwid, nararapat na consideration and select the proper speed.

2) Reduction of vessels' weight

This technique is applicable to all fishing vessels but is especially effective for small fishing vessels. When the total vessel weight increases as fuel, fishing gear and catch increase, the displacement increases as well which will make the fuel consumption to rise with the increasing of the propulsion resistance. It is therefore recommended that unused fishing gear should be stored in onshore storage facilities and that the amount of fuel loaded in vessels be reduced in the necessary minimum. As for small-sized coastal fishing vessels, it is necessary to pay attention to the proper methods of loading fishing gear and fish catch to keep the trim of the vessels in proper condition and avoid excessive trim. Excessive trim in the bow or stern could lead to increased fuel consumption and deteriorate the sea keeping and maneuverability.

3) Cleaning of hull, rudder and propeller

This technology is applicable to all fishing vessels regardless of type of vessels, size and types of fisheries. Immediately after docking, the hull, stern, propeller and other parts should be kept clean. However as days go by, these parts could get dirty due to the attached algae, shellfish and other creatures making it difficult to sail at predefined speed because of increased friction drag which also increases the fuel consumption. Cleaning periodically will improve the situation, and if it is not possible to frequently dock the vessels, cleaning of the propellers by divers will surely show certain effects on the saving energy

4) Proper utilization of controllable pitch-propeller

Some fishing vessels which are operated offshore and in deep-seas such as trawl and tuna long-lines are equipped with controllable pitch-propeller. At the bridge of those fishing vessels, there is usually a control board to set the "propeller pitch" and "rotating speed". Controlling the vessel speed merely by the pitch when the engine constantly rotates will significantly decrease the efficiency of the propeller while slowing down, and this could make fuel consumption to rise. Although this depends on the condition of the load on vessels, speed and condition of operation, reduction of fuel consumption can be expected by operating both pitch and rotating speed. In particular, it is encouraged that the vessel is operated with the proper setting while the "pitch" and "rotating speed" are controlled simultaneously according to the "operation manual" of controllable pitch-propeller which is provided by propeller manufacturers and shipyards.

pag-aralang mabuti ang sitwasyon at piliin ang tamang bilis.

2) Pagpapapagaan sa bangka

Ang pamamaraang ito ay maaaring gamitin sa lahat ng uri ng bangka at mas higit para sa maliliit na uri. Kapag ang bigat ng bangka ay tumaas dulot ng dagdag na bigat ng langis-panggatong, gamit-pangisda, at huling isda, ang *displacement* ay tataas din na siyang magpapataas ng konsumo gawa ng pagtaas ng *propulsion resistance*. Makabubuting iwanan ang hindi gagamiting gamit-pangisda at maglagay lamang ng tamang dami ng langis-panggatong. Sa mga maliliit na bangka, makabubuting bigyang pansin ang pagsasaayos ng gamit-pangisda at mga huling isda upang maiwasan ang labis na pagkalubog. Ang labis na pagkalubog, maging sa harapan o likurang bahagi ng bangka ay maaring magpataas ng konsumo at magpahirap sa pagkontrol.

3) Paglilinis ng katawan ng bangka, timon at pala

Ang pamamaraang ito ay maaring gamitin sa lahat ng uri ng bangkang pangisda. Pagkaangat ng bangka, ang katawan, timon, pala at iba pang bahagi ay dapat mapanatiling malinis. Sa katagalan, maaring may maiwang mga dumidikit na taliptip na makapagpapabagal sa takbo ng bangka at makapagpapataas ng konsumo. Ang palagiang paglilinis ay makakatulong, at kung hindi naman maaaring iangat ng palagian ang bangka ay maaring sisirin ang pala upang linisin nang sa gayon ay magkaroon ng epekto sa pagtitipid ng enerhiya.

4) Paggamit ng *controllable pitch propeller*

Ilan sa mga bangkang pangisda na ginagamit sa malalim na bahagi ng karagatan tulad ng sa galadgad at pangawil ng tuna ay may *controllable pitch propeller*. Sa may *bridge* ng bangka matatagpuan ang *control board* kung saan maaaring galawin ang *propeller pitch* at bilis ng ikot ng pala. Ang pagkontrol sa posisyon ng talim ng pala (*pitch*) habang hindi nagbabago ang bilis ng ikot ng makina ay magpapabagal lamang ng takbo ngunit maari pang makapagpataas ng konsumo. Mas mainam na sabay ilagay sa tama ang posisyon ng talim ng pala at bilis ng ikot ng makina upang maasahan ang pagbaba ng konsumo. Mainam na basahin at isagawa ang sabayang pagtatama ng *pitch* at bilis ng ikot ng makina alinsunod sa mungkahi ng pagawaan.

(2) Energy saving technology by proper remodeling of hulls

1) Installation of bulbous bow

The protruding bulb at the bow of a vessel just below the waterline is called a bulbous bow or bow bulb. The speed –length ratio of fishing vessels including offshore and deep-sea fishing vessels, is usually high, therefore wave making resistance (vessel resistance is generated by the formation of waves as the vessel passes through the water) accounts for a large portion among the total resistance of the vessels. In order to reduce wave making resistance, giving large displacement volume to the edge of the bow is efficient, and in theory, it has become clear that it is better to increase the displacement volume in the edge of bow as the speed increases for the displacement type of vessels. Therefore, this technology is especially efficient for the vessels which are operated offshore and in deep-seas.

Bulbous bow is specially constructed to give displacement volume to the edge of bow because the proper size depends on the speed-length ratio (square root ratio of speed and the length of vessel). As for the specific design and construction, there is a need to consult with research institutes, building shipyards, and design consultants capable of designing effective size and form. Since big waves occur in the water where the transverse area changes significantly, there is a need to smoothly put the installed parts of the bulbous bow and the main hull in order that the transverse area does not change significantly towards the direction of the length of vessels. Furthermore, in case the emerging bow hits the sea surface during big waves, the bulbous shapes making a cross-section surface would be able to prevent the vessel bottom from getting big damages and the other bulbous shapes could prevent any problems in the structural strength of the vessel when big waves are present in the ocean.

In general, these methods are not effective for small-sized coastal fishing vessels due to the fact that these vessels should sail over a speed-length ratio of the bulbous bow to be effective. However, for some small-sized coastal fishing vessels, the bow has similar form and is used for the purpose of ensuring the buoyancy of the bow and increasing the length of the water line.

Offshore and deep-sea fishing vessels which are not yet equipped with bulbous bows and those with bulbous bows that are not in proper form, could expect reduction in fuel consumption by equipping these vessels with bulbous bow or improving the form of their bulbous bows.

2) Fins fitted forward of propeller

This is a device which could enhance propulsion efficiency mainly for deep-sea and offshore fishing vessels. Several fins are attached in a radical fashion around the stern in front of propellers through which the hull attachment current fins commutate the flow into the propellers and also recover rotational energy. As attachment position of the current plate, form, size and the number of alignment are related to the underwater form of the vessels depending on speed of vessels, it will be essential to pre-consider carefully about equipping vessels with current plate in consultation with appropriate research institutes, building shipyards, design consultants, and others.

(2) Pagtitipid ng enerhiya sa pamamagitan ng pagsasaayos ng katawan ng bangka

1) Paglalagay ng *bulbous bow* o bulbo

Ang nakausling bahagi sa harapan ng bangka sa baba ng linya ng tubig ay tinatawag na bulbo. Ang katumbasan ng bilis at haba ng bangka ay karaniwang mataas kung kaya't ang pagsuong ng bangka sa alon ay kumakatawan sa kalakhang bahagi ng kabuuang paglaban (resistance) ng bangka. Upang mabawasan ito, ang pagkakaroon ng malaking *displacement volume* sa harapan ay maigi, at sa teorya, mas mabuting taasan ang *displacement volume* sa unahan kaakibat ng bilis ng bangka para sa mga *displacement type* na bangka. Sa makatuwid, ang teknolohiyang ito ay tumpak para sa mga bangkang ginagamit sa pang-malalimang pangingisda.

Ang bulbo ay ginawa upang magkaroon ng *displacement volume* sa dulo ng harapang bahagi ng bangka sapagkat ang tamang laki ay nakabatay sa katumbasan ng bilis at haba ng bangka (*square root ratio of speed and the length of vessel*). Makabubuting sumangguni sa mga kinauukulan gaya ng mga mananaliksik, pagawaan, at mga bihasa upang malaman ang tamang disenyo at pamamaraan. Makatutulong din ang bulbo upang maiwasan ang pagkasira ng bangka kapag ito ay humampas sa alon at tubig habang naglalayag.

Karaniwang ang pamamaraang nabanggit ay hindi epektibo sa maliliit ng mga bangkang pangisda sapagkat ang mga ito ay kinakailangang maglayag ng higit sa katumbasan ng bilis at haba ng bangka base sa bulbo upang maging mabisa. Gayunpaman, sa ilang mga maliliit na bangka, ang unahan ay dinisenyo upang siguruhin ang paglutang at paglawak ng *water line*.

Ang mga malalaking bangkang hindi pa gumagamit ng ganitong teknolohiya ay maaring makatipid ng konsumo kung susundin ang mga naunang mungkahi ng paglalagay ng bulbo.

2) Paglalagay ng palikpik (*fins*) sa harap ng pala

Ang gamit na ito ay makatutulong sa husay ng pagtulak ng mga bangkang ginagamit sa malaliman at malayuang pangingisda. Ang mga palikpik ay nilalagay sa palibot ng popa na nasa harap ng pala upang mabawi ang enerhiyang nagamit sa pag-ikot ng makina. Makabubuting sumangguni sa mga kinauukulan gaya ng mga mananaliksik, pagawaan at mga bihasa upang malaman ang tamang disenyo at pamamaraan.

3) Shape refinement of the appendages of hull

This is an efficient technology for the fishing vessels operated offshore and in deep-seas. There are many objects around hull creating vortex and making resistance. These objects are the attachments or appendages such as the skeg (skeg is an aggregate of a part located longitudinally at the center of the vessel's bottom which is called "keel", a fin looking object which sticks out from keel, and is so-attached so that vessels could be operated to go straight ahead) , bilge keel (a plate which is attached to the bottom of hull's side to reduce rolling.), sonar, transducer of the fish-finder, and also the aperture of the side thruster. The function of these attachments will be relatively bigger since the hull of fishing vessel is smaller compared with that of large commercial vessels. Depending on the type of fishery, equipment such as propeller guard may be added. Propulsion resistance could be improved by refining the attachments to their proper forms along a streamline.

As for large-scale purse seine fishing vessels, sonar and transducer of the fish finder which are scattered around the bottom of the vessel are re-equipped altogether within the framework of the hull on keel line. As the result, a certain amount of fuel is reduced.

For long-line tuna fishing vessels, fuel consumption could be reduced by refining each form of the bilge keel, the transducer box of the fish-finder and anode protections on hull and rudder. However, in improving the transducer box of fish-finder, it is necessary to consider the improvement method carefully as there is a possibility of noise occurring in the fish-finder. This is due to the fact that air bubbles which are caused by the waves near the bow could flow into the transducer along the vessel's bottom in the case of improperly improvement.

(3) Energy saving technology by proper replacement of engine

1) Replacement of engines

This is a technology which is expected to be effective for small size coastal fishing vessels.

The replacement from old engines to new ones may be necessary for small size coastal fishing vessels. Improvement in fuel consumption can be expected by replacing from old engines used over 10 years to the new ones. Fuel consumption rate per out power may be improved, however, fuel consumption may increase in case of performance delivery at full capacity owing to the fact that the horse power of new engines is larger than that of old ones in general. There were cases that small size pole-and-line fishing vessels equipped with engines with 600 horsepower were using less than 300 horsepower in order to save fuel, estimating from measuring result of fuel consumption. Using engines of significant power with low load and bad fuel consumption rate for a long time is not only inconvenient in sides, fuel consumption and initial investment for replacement of engines, but it may also lead to the damage of engines due to low load injury. In case of new construction and replacement, selecting proper output engine is the most important thing in energy saving.

3) Pagbago sa katawan ng bangka

Ito ay mahusay na teknolohiya para sa pang-malaliman at pang-malayuang bangkang pangisda. Mayroong mga bagay sa ilalim ng bangka na maaaring lumikha ng puyo at dagdag na paglaban ng bangka sa tubig. Ang mga ito ay nakakabit sa katawan ng bangka kagaya ng *skeg* (*skeg is an aggregate of a part located longitudinally at the center of the vessel's bottom which is calLED keel, a fin-looking object which sticks out from keel, and is so attached so that vessels could be operated to go straight ahead*), bilga o *bilge keel* (*a plate which is attached to the bottom of hull's side to reduce rolling*), *sonar*, *transducer* ng *fish-finder*, at ang *aperture* sa gilid ng *thruster*. Ang gamit ng mga ito ay mas malaki para sa mga maliliit na bangka kumpara sa mga malalaki. Ang paglaban sa tulak ng bangka sa tubig ay maaring mabawasan sa pamamagitan ng pagbago sa mga nakakabit sa katawan ng bangka gaya ng paglalagay ng giya sa pala.

Sa mga malalaking pangulong, ang mga *sonar* at *transducer* ng *fish finder* na nakakalat sa ilalim ay maaring ilinya ayon sa hugis ng katawan ng bangka. Ito ay magbubunga ng katipiran sa konsumo.

Para sa mga bangkang pangawil ng tuna, maaring mapababa ang konsumo sa pamamagitan ng pagsasaayos ng bilga, *transducer box* ng *fish finder* at *anode protections* sa ilalim at timon. Sa pagsasaayos ng *transducer box* ng *fish finder*, marapat na piliin ang pamamaraan upang maiwasan ang pagkakaroon ng malakas na ingay dulot ng mga bula na gawa ng alon sa harapang bahagi.

(3) Pagtitipid ng enerhiya sa pamamagitan ng pagpapabago ng makina

1) Pagpalit ng makina

Ang teknolohiyang ito ay inaasahang mahusay para sa mga maliliit na bangkang pangisda. Makakatipid ng konsumo kung papalitan ang mga lumang makina na umabot na ng 10 taon. Gayunpaman, ang katumbas na konsumo kada lakas ng makina ay maaaring bumaba ngunit malamang na tumaas ang kabuuang konsumo sapagkat ang mga bagong makina ay nagtataglay ng mas mataas na lakas-kabayo. May mga kaso na ang bangkang pangisdang may 600 lakas-kabayong makina ay naglalayag ng mas mababa sa 300 lakas-kabayo upang makatipid ng konsumo. Ang paggamit ng makinang may sapat na lakas sa pamamaraang hindi angkop, gaya ng magaang karga at mataas na konsumo ay maaring magresulta sa maagang pagkasira at palagiang pagpapalit ng makina. Sa pagpapalit ng makina, maiging piliing mabuti ang kinakailangang lakas upang makatipid ng enerhiya.

2) Main engine drive of generator and other auxiliary machines

Concerning generator of offshore and deep-sea fishing vessels, it is possible to save energy by driving on the main engine which has better fuel consumption rate compared to auxiliary engine. Transmission efficiency will improve by directly driving auxiliary machines such as refrigerator by main engine and auxiliary engine for that there is no electrical conversion. However, as direct-drive of refrigerator make the system complicated; it has been applied to only small proportion of deep-sea tuna long-line fishing vessels. In case generator is driven by main engine, it is important to keep the frequency constant. There are 2 ways to do so, one is the method of using the main engine in a constant rotation frequency and control the speed merely by controllable pitch propeller (CPP). Another method is to install constant frequency unit between main engine with variable rotation frequency and generator or behind the generator. As for the former method, if the propeller is rotating fast when navigating slow by tuna long-line fishing vessels, propeller efficiency will drop and will lead to increase in fuel consumption. Of the latter, when using constant frequency unit which maintains regular rotating frequency of generator by slipping electronically or mechanically, the transmission efficiency will be reduced, in case the main engine is in high rotative speed. This will lead to the increase in fuel consumption. There are models which ease negative effects by using 2-speed system. Furthermore, as for thyristor inverter system which converts to constant frequency alternating current after commutating variable frequency alternating current, high transmission efficiency can be expected regardless of the number of rotations of main engine. However, it may be difficult to operate parallel with the generator driven by auxiliary engine. It is necessary to take measures against noise for measurement equipment and communication device for the reason that inverters cannot prevent electrical noise to generate.

Energy saving of the drive of main engine is becoming less effective with the gap of fuel consumption between main engine and auxiliary engine shrinking compared to the past, although it depends on the output power of engines. Therefore, it is essential to consider comprehensive cost including reduction of maintenance cost and so forth by the main engine of generator being able to back up the auxiliary engine completely. Therefore, regarding auxiliary machines and the main engine drive, you need to consider the effects with technicians who are familiar with the system.

3) Control of rotating speed of pump and other equipment by inverter

Seawater coolant pumps which are used in main engines and auxiliary engines of offshore and deep-sea fishing vessels are driven at constant speed by three-phase induction motor. On the other hand, while the heat quantity of coolant water and lubrication oil which needs to be cooled may vary depending on the load condition of engines and equipment, in general certain amount of room in addition to the maximum value is selected for the pump capacity, and also provide cooling device with maximum flow. Using variable amount pump which is able to adjust the number of rotations and provide the required coolant water for heat discharge, is an effective power saving measurement.

2) Pagkawing sa mga kasangkapan sa pangunahing makina

Para sa mga malaliman at malayuang bangkang pangisda, makabubuting ikawing ang mga kasangkapan sa pangunahing makina sapagkat ito ay may mas mainam na konsumo kumpara sa pantulong na makina. Ang *transmission efficiency* ay mapapanatili kung ikakawing ang mga kagamitang tulad ng *refrigerator* sa pangunahing makina sapagkat hindi na mangangailangan ng pagbabago ng kuryente. Dahil sa maligalig na sistema ng *refrigerator*, ito ay ginagamit lamang sa ilang mga pangawil ng tuna. Kapag ang *generator* ay pinatatakbo ng pangunahing makina, mahalagang hindi magbago ang *frequency*. May dalawang pamamaraan na magagamit, una ay ang pagpapanatili sa pangunahing makina sa *constant rotation frequency* at pamamahala sa bilis sa pamamagitan ng *controllable pitch propeller* (CPP). Ang pangalawa ay ang pagkakabit ng *constant frequency unit* sa pagitan ng pangunahing makina at makinang may *variable rotation frequency*. Sa naunang pamamaraang nabanggit, kapag ang pala ay umiikot ng mabilis habang naglalayag ng mabagal, ang husay ng pala ay babagsak at hahantong sa mataas na konsumo. Sa pangalawang solusyon, maari ring tumaas ang konsumo kapag ang bisa ng paghahatid ng enerhiya ay bumaba bunsod ng pagpapanatili sa higit na mabilis na ikot ng makina. Mayroong mga modelong makakalutas dito na gumagamit ng dalawang sistema ng bilis. Dagdag pa rito, sa mga may *thyristor inverter system* na nagkakaroon ng *constant frequency alternating current*, kaya mataas na *transmission efficiency* ang maaasahan maging anuman ang bilang ng ikot ng pangunahing makina. Subalit magiging mahirap ang pagpapatakbo kaalinsabay ng *generator* na nakakawing sa pangunahing makina. Kinakailangang isaalang-alang ang ingay na maaring mapunta sa mga gamit panukat at pantawag sapagkat ito ay hindi mapipigilan ng mga *inverter*.

Makabubuting komunsulta sa mga manggagawang may alam sa mga pamamaraang ito upang maging katanggap-tanggap ang resulta.

3) Pamamahala sa bilis ng ikot ng bomba at iba pang kasangkapan gamit ang *inverter*

Ang mga bombang pampalamig na ginagamit sa mga pangunahin at pantulong na makina ng mga pang-malaliman at pang-malayuang bangkang pangisda ay pinatatakbo sa palagiang bilis ng *three phase induction motor*. Sa kabilang banda, datapwa't ang kargang init ng tubig na pampalamig at langis-pampadulas na kailangang palamigin ay nakasalalay sa bigat ng paggamit sa makina at mga kasangkapan, naglalagay pa rin ng mas mataas na kapasidad ng bomba at gumagamit ng pampalamig na sagad ang buga. Ang paggamit ng bombang maaring baguhin ang dami ng ibinubugang pampalamig ay mahusay na pagtitipid ng enerhiya.

In particular, fuel consumption is reduced by methods as follows. It can be reduced by controlling the temperature difference in the doorway for coolant water by making the speed of motor which drives the coolant water pump of main engine adjustable by inverter regardless of the load of main engine. Second method is to control discharge pressure to be constant by making the speed of motor which drives coolant water pump of several auxiliary engines adjustable regardless of the number of operating auxiliary engines. It can be widely-applied by using similar methods such as trying to save energy by adjusting displacement water volume according to the decrease in the number of live bait fish from operations through making it possible to adjust the speed of the pump for warehouse to farm live bait at low temperature used in skipjack pole-and-line fishing,

4) Improvement of power factor using phase advancing condenser

It is a technology which is applicable and effective to both offshore and deep-sea fishing vessels.

The loss of electric power in circuit is reduced to the square of electric current. For that time lag occurs between the changes of voltage and electric current, there will be a huge loss of electric power in case high current flows at low voltage. Therefore, setting a condenser (Phase advancing condenser) which is able to adjust time lag will reduce electric current and will ease loss of electric power. (Improve power factor) However, if the vessel does not have electric power loss from the time of new vessel constructed, setting phase advancing condenser will not have much improvement effect. When introducing the condenser, it is necessary to consult with experts for that proper condenser volume should be selected depending on the vessel and also that proper connection method should be chosen.

(4) Energy saving technology for using fishing gear

1) Low-resistance fishing gear

This is an effective technology for trawl fishing vessels operated in offshore and deep-seas. The output power of the main engine while towing, is proportional to the resistance of fishing gear of trawler using such as trawling nets. Therefore, energy saving effects can be expected by reducing the resistance of the fishing gear. Nets of trawl fishing vessels are generally made of polyester. Using ultra high-strength polyester fiber which is 4 times as strong as the normal fiber in right places of the fishing gear will make the diameter of net twine thinner, and also by enlarging the mesh size of parts which do not have big influence on fishing such as the wing-like attachments, the resistance of the fishing gear could be reduced. This technique has been used in some offshore trawl fishing vessels and the energy saving effects had been confirmed.

For small-sized coastal trawl fishing vessels, it is difficult to use less resistance fishing gear like the ones used in offshore trawl fishing vessels as of this moment, as thinner line is generally used for nets compared to deep-sea and offshore trawl fishing vessels, and it is difficult to find even thinner and proper sized ultra-high-strength fiber. However, alternative ways could be developed to reduce resistance such as enlarging the size of mesh of the parts like the wing-like attachments which do not have much influence on fishing.

2) Operation of hydraulic pump and hydraulic system

Ang konsumo ng langis-panggatong ay maaaring mabawasan sa pamamagitan ng mga sumusunod. Maaaring pamahalaan ang pagkakaiba ng temperatura sa daanan ng tubig-pampalamig sa pamamagitan ng paggamit ng *inverter* na uri ng makina na walang kinalaman sa kinakarga ng pangunahing makina. Ang ikalawang paraan ay pagpapanatili sa *discharge pressure* sa pamamagitan ng nababagu-bagong bilis ng ikot ng pantulong na makina, maging ilan man ang gumaganang pantulong na makina. Maliban sa mga nabanggit, maari ring gumamit ng iba pang kahalintulad na pamamaraan sa pagtitipid ng enerhiya gaya ng pagbabawas ng tubig kapag kakaunti ang dalang buhay na isdang-pain.

4) Pagpapabuti sa *power factor* gamit ang *phase advancing condenser*

Ito ay teknolohiyang maaring gamitin para sa malaliman at malayuang bangkang pangisda. Ang kawalan ng kuryente sa sistema ay nasasadlak sa parisukat (*square*) ng kuryente. Dahil sa agwat ng panahon sa pagitan ng pagbabago sa boltahe at kuryente, magkakaroon ng kawalan sa kaso ng mataas na kuryenteng dumadaloy sa mababang boltahe. Sa makatuwid, ang paglalagay ng kondenser (*phase advancing condenser*) na makapagpapaikli ng agwat ng panahon ay magbabawas ng kuryente at kakapusan ng enerhiya (*improve power factor*). Sa pagkakabit ng kondenser, marapat na sumangguni sa mga bihasa para sa tamang sukat, uri at paraan ng pagkabit.

(4) Pagtitipid ng enerhiya sa pamamagitan ng gamit-pangisda

1) Magaang-laban (*Low-resistance*) na gamit-pangisda

Ito ay mabisang teknolohiya para sa galadgad sa malalim at malayuang pangingisda. Ang *output power* ng pangunahing makina habang humuhila ay katumbas ng paglaban ng gamit-pangisda gaya ng mga panggaladgad na lambat. Sa makatuwid, makapagtitipid ng enerhiya kung mababawasan ang paglaban ng gamit-pangisda. Karaniwang gawa sa *polyester* ang mga lambat-panggaladgad. Mapapababa ang paglaban ng gamit-pangisda sa pamamagitan ng paggamit ng hiblang *ultra high-strength polyester* na 4 beses na mas matibay kaysa sa karaniwang hibla at makapagpapaliit sa bantod ng tali. Maging ang pagpapalawak sa mata ng mga parteng hindi masyadong mahalaga gaya ng mga pakpak ay makakatulong din. Patutunayan ito ng mga naggagaladgad na nakasubok na ng ganitong pamamaraan.

Para sa mga malilit na pangisda, mahirap humanap ng gamit-pangisdang mababa ang paglaban sapagkat karaniwan sa mga lambat ay ginagamitan na ng mas maliliit na hibla. Subalit maaari pa ring humanap ng ibang paraan gaya ng paggamit ng mas malalaking mata ng lambat sa mga bahagi gaya ng pakpak na hindi masyadong nakakaapekto sa pangingisda.

2) Pamamahala sa *hydraulic pump* at *hydraulic system*

Many fishing vessels including offshore trawl fishing vessels are driven by hydraulic pump which is the source of power of the main engine for the fish catching machines such as the winch. Most of the hydraulic systems use circuit which is a combination of constant-volume motor and constant-volume pump. As pump is driven by the main engine, it discharges certain amount of oil. The winch drum adjusts the flow regulating valve in order to obtain the required rotations and provides the hydraulic motor with the necessary quantity of oil. Although excessive oil bypasses down the system, when oil is flowing inside the pipes, the result is loss of energy. In general, loss of energy can be reduced when pumps are equipped with enough room for the volume of hydraulic motor and lower the discharge volume of pumps by reducing the number of rotations of the main engine. Using constant pressure and variable amount of oil for the hydraulic pump system which only provides necessary quantity of oil for the hydraulic motor, will not result in loss of energy as mentioned above and thus energy could be saved.

(5) Energy saving technology which is available to contemplate the construction of a new fishing vessel

1) High efficiency propulsion system such as contra-rotating propellers

Large-scale purse seine fishing vessels "Nippon-Maru", for example, is equipped with a tandem of propulsion device such as main engine-driven propeller and electric motor-driven propeller in rudder, which are fitted rudder each other. The device is one of the contra-rotating type propeller and propulsion efficiency improved by rear propeller recovering the rotating energy generated by the main engine drive propeller. This system can be used as stern thruster by operating the rudder with electric motor drive propeller while fishing. Establishing a method of using tandem propulsion device during fishing operation and navigation, and also analyzing the maintenance cost of the system, are should be clarified in the future.

2) Double reduction of main engine

In fixed-pitch propellers for trawl fishing vessels of which loading depends on whether it is navigating or trawling, and for set net fishing vessels which have huge gap between the ballast or when it is fully loaded, these propellers are so-designed as to avoid the engine from being in a torque rich situation.

Adapting two-stage deceleration system will make it possible to select the number of rotations according to the propulsion resistance of two different situations, such as when it is navigating or when it is trawling (or in case the vessel is fully loaded). In this way, without using expensive controllable pitch propeller, it is possible to drive the vessel efficiently as well as optimize the engine performance without overloading, which will subsequently result in energy saving.

3) Cost saving by using economical oils such as marine fueloil and blended oil

Using marine fuel oil which is cheaper than marine diesel oil (marine fuel oil costs about 80% of marine diesel oil in our country) or using blended oil which is a mix of marine fuel oil and marine diesel oil is expected to save cost. marine fuel oil is made of residue of gasoline, kerosene and light oil refined from crude oil, and it shows large variation in its form due to refinement method and the type of crude oil used. Fuel heater is necessary for that marine fuel oil is high viscosity. Also, as marine fuel oil includes many foreign substances and impurities, Maraming bangkang pangisda, kabilang na ang mga malalaking galadgad, ang ginagamitan ng *hydraulic pump* na siyang pinagmumulan ng lakas para sa pangunahing makinang pangisda gaya ng tambor. Karamihan sa mga *hydraulic systems* ay gumagamit ng *circuit* na kumbinasyon ng *constant volume motor* at *constant volume pump*. Habang pinapatakbo ng pangunahing makina ang bomba, ito ay naglalabas ng langis. Ang *winch drum* ang nagpapagana sa *flow-regulating valve* upang makuha ang kaukulang ikot at naglalaan ng tamang dami ng langis para sa *hydraulic motor*. Datapwa't labis na langis ang hindi dumadaan sa sistema, kapag dumadaloy ang langis sa loob ng tubo, ang resulta ay kawalan sa enerhiya. Sa pangkalahatan, ang kawalan sa enerhiya ay maiiwasan kung magbibigay ng sapat na lugar para sa dami ng *hydraulic motor* at mapapababa ang tapon ng bomba sa pamamagitan ng pagbawas sa bilang ng ikot ng pangunahing makina. Mabisa ring panatilihin ang *constant pressure* at baguhin ang dami ng langis sa *hydraulic pump* upang makadagdag sa katipiran.

(5) Pagtitipid ng enerhiya sa pamamaraang akma habang ginagawa ang bangka

1) Mahusay na *propulsion system* tulad ng *contra-rotating propellers*

Ang mga malalaking pangulong na bangkang pangisda gaya ng *Nippon Maru* ay gumagamit ng kumbinasyon ng *propulsion device* gaya ng palang nakakawing sa pangunahing makina at palang pinapatakbo ng kuryente sa may timon. Ang kagamitan ay isa sa mga *contra-rotating* na uri ng pala at ang *propulsion efficiency* ay napapabuti ng panlikod na pala na siyang bumabawi sa enerhiya ng pag-ikot na nanggagaling sa palang pinatatakbo ng pangunahing makina. Ang sistemang ito ay maaaring gamitin bilang *stern thruster* sa pamamagitan ng timon na may palang pinatatakbo ng kuryente habang nangingisda. Ang pamamaraang ito ay kinakailangang suriing mabuti sa nalalapit na hinaharap.

2) *Double reduction* ng pangunahing makina

Para sa mga may *fix-pitch propellers* gaya ng mga bangkang panggaladgad kung saan ang pagkarga (*loading*)ay magkaiba para sa paglalayag at pangingisda, at para sa mga bangkang may malaking agwat sa *ballast*, ang mga palang ito ay dinisenyo upang maiwasan ang paglabis ng puwersa sa makina.

Ang paggamit ng dalawang yugto ng pagpapabagal ng takbo ay magbibigay daan sa pagpili ng bilang ng ikot ayon sa *propulsion resistance* sa magkaibang sitwasyon: naglalayag at nangingisda (o hindi kaya'y puno ang bangka). Sa ganitong paraan, habang hindi gumagamit ng mahal na *controllable pitch propeller*, maaring mahusay na mapatakbo ang bangka at maiwasan ang pagkapuwersa ng makina, na mauuwi sa katipiran sa enerhiya.

3) Pagtitipid sa pamamagitan ng paggamit ng murang langis gaya ng *marine fuel oil* at *blended oil*

Mas mainam gumamit ng *marine fuel oil* na mas mura kaysa sa *marine diesel oil* (ang *marine fuel oil* ay nagkakahalaga ng halos 80% ng *marine diesel oil* sa ating bansa), o hindi kaya'y *blended oil* na pinaghalong *marine fuel oil* at *marine diesel oil*, upang makatipid. Ang *marine fuel oil* ay gawa sa latak ng gasolina, gaas at *light oil* na pinino mula sa krudo, at ito ay nagpapakita ng malaking pagkakaiba batay sa paraan ng pagpino at uri ng krudong ginamit. Ang *fuel heater* ay kinakailangan sapagkat malapot ang *marine fuel oil*. Dahil na rin sa madaming dumi ang *marine fuel oil* kailangang gamitan ito ng *centrifugal cleaning equipment*. Bukod sa matrabaho ito, mas mataas ang karga nitong *carbon/hydrogen* kumpara sa *marine diesel oil* na magreresulta sa pagtaas ng *carbon dioxide emission*. Dagdag pa rito, kailangan ding bigyang pansin ang nakalalasong kemikal gaya ng *NOx* at *sulfur oxide* (*SOx*) sa usok.

centrifugal cleaning equipment is necessary in order to get rid of them when using marine fuel oil. This requires a lot of energy and in addition to that, the proportion of Carbon/Hidrogen is high compared to marine diesel oil which increases the carbon-dioxide emission. What is more, it is necessary to consider that hazardous substances such as NOx and sulfur oxide (SOx) in emissions and particle matter may increase.

When starting and stopping the engine and in case of low loading, marine fuel oil should be switched to marine diesel oil. Engine parts including fuel valve are expected to become run down faster than usual. As for domestic vessels, there is a past record of marine fuel oil being used for 500 ton class vessels; however, considering the facility aspect of engine room, this will possibly be introduced to only large scale fishing vessels. Maintenance cost and increase of labor of crew members should be taken into account in order to determine economic efficiency, therefore verification test using large scale fishing vessels is essential. In addition, the route of marine fuel oil acquisition should be considered. (In general, blended oil cannot be acquired in Japan.)

The use of marine fuel oil is introduced as 2-year-plan from 2008 to 2009 of "Project to urgently substantiate the cost-saving technology in fishing vessels" in the project by Fisheries Agency called "Technology development project towards appealing fishing industry".

(6) Energy saving technology to be considered in the future

1) fishing vessels with sail-assisted propulsion

When the prices of fuel rise, the idea of using wind energy by setting the navigating equipment in fishing vessels ,that is, a fishing vessel with sail-assisted propulsion, is usually proposed. However, this idea has never become widely-used except for special fishing vessels such as small trawler. Because there are many demerits in using a sail for fishing vessels and those demerits may eliminate the fuel savings gained by using a sail. The demerits could include the fact that simple sail navigating equipment will make it complicated to sail handlings and an automatic sail control system will increase the initial cost. It will also cause problems such as increased maintenance cost, the sail hindering the vision of crew, and narrowing down the working deck space.

An ocean-going long-line tuna fishing vessel equipped with cybernated hard sail was constructed in mid 1980s with the aid of Nippon Foundation, but it is not sure whether such fishing vessel still uses the sail. Domestic vessels which were constructed with the same concept are still operating but the sails have been removed. Nevertheless, for large-scale commercial vessels, equipment which resembles a kite which is called a "kite sail" has been proposed, but this was found to be difficult to introduce to fishing vessels. Depending on both the wind velocity and the wind direction relative to the vessel's course (wind speed and wind direction against to the vessel during operation), the equipment could require more fuel. In addition, it is difficult to get the same speed as the conventional speed by wind energy for high-speed coastal fishing vessels.

Recently, simple rig using soft sail made of cloth was tried to be introduced for ocean going long-line tuna fishing vessels. The reports is discussed on the selection system of most appropriate meteorological course in order to gain the maximum wind energy. However, this concept is still to be introduced in the fishing industry. Utilization of wind energy is an important research project as it is a propulsion device which does not depend on fossil fuel.

Kapag nagpapaandar at nagpapatigil ng makina nang hindi puno ang bangka, dapat lumipat sa *marine diesel oil* mula sa *marine fuel oil*. Ang mga bahagi ng makina, kabilang na ang *fuel valve*, ay luluma nang mas mabilis kaysa sa inaasahan. May naitalang paggamit ng *marine fuel oil* sa mga bangkang nasa 500 toneladang kategorya; subalit malamang na ito ay angkop lamang sa mga malalaking bangkang pangisda dahil sa kakailanganing laki ng kwarto ng makina. Ang gastos sa pagmintina at dagdag na kawani ay kinakailangang pag-aralan upang malaman kung ito ay pasado sa *economic efficiency*, kung kaya't kailangang subukan ito gamit ang malalaking bangkang pangisda. Dagdag dito, kailangang isaalang-alang ang paraan ng pag-angkat ng *marine fuel*. (Sa pangkalahatan, hindi makakakuha ng *blended oil* sa *Japan*.)

Ang paggamit ng *marine fuel oil* ay iminungkahi sa 2-taong plano mula 2008 hanggang 2009 sa *Project to urgently substantiate the cost-saving technology in fishing vessels* sa proyekto ng Ahensiya ng Pangisdaan na tinawag na *Technology development project towards appealing fishing industry*.

(6) Pagtitipid ng enerhiya sa hinaharap

1) Bangkang pangisda na may layag

Kapag tumataas ang presyo ng langis, iminumungkahi ang paggamit sa enerhiyang mula sa hangin sa pamamagitan ng layag. Subalit hindi naging malawakan ang paggamit sa kaisipang ito liban sa mga maliliit na galadgad sapagkat ang mga negatibong aspeto sa paggamit ng layag ay maaring tumumbas sa katipirang matatamo. Isa sa mga negatibong aspeto ay ang kumplikadong paggamit sa layag at ang dagdag na gastos kung bibili ng *automatic sail control system*. Magdudulot din ito ng mas mataas na gastos sa pagmintina, abala ng layag sa paningin, at pagliit ng lugar ng gawaan dahil sa layag.

Isang bangkang pangisda na gumagamit ng kawil para sa tuna ang nilagyan ng *cybernated hard sail* noong kalagitnaan ng 1980s sa tulong ng *Nippon Foundation* ngunit hindi rin malaman kung nagagamit pa ang naturang layag. Ang iba naman na ginamitan ng kaparehas na pamamaraan ay ginagamit pa subalit tinanggalan na ng layag. Ang mga malalaking bangkang komersiyo ay iminungkahing gumamit ng *kite sail* subalit napag-alamang mahirap itong ilagay sa mga bangkang pangisda. Depende sa lakas ng hangin at direksyon nito na may kinalaman sa tutunguhin ng bangka, ang kagamitan ay maaring mangailangan ng dagdag na gatong. Dagdag dito, mahirap matumbasan ang bilis ng *high-speed* na bangkang pangisda kung aasa lamang sa enerhiya ng hangin.

Kamakailan lamang ay sinubukang gamitan ng layag na gawa sa tela ang mga bangkang pangawil ng tuna. Ang ulat ay tumuon sa paghahanap ng angkop na direksyon upang makamit ang pinakamataas na enerhiya ng hangin. Subalit ang kaisipang ito ay susubukan pa lamang sa mga bangkang pangisda. Ang paggamit ng enerhiya mula sa hangin ay mahalagang saliksikin sapagkat ito ang uri ng paglalayag na hindi nakasalalay sa langis-panggatong.

2) Wind generation and solar power generation

The use of natural energy such as wind electricity and solar power is now drawing much attention. Utilizing wind energy as new source of energy for fishing vessels include not only using wind energy as a power source for the rig but also for charging battery using the electricity generated by installing a windmill in fishing vessels. This is then used as navigation device, fish catching device, onboard pumpss and drive-power of continuous current device such as the rig device. In installing solar battery in fishing vessels, the best location would be on the bridge of existing vessels. However in most cases, navigational devices are already on the bridge and making room for things like a windmill would be an issue to consider.

3) Biodiesel Fuel

Biodiesel fuel (BDF) which is a general term for fuel used for diesel engine, is a biomass energy made from biological oil. Based on the idea of carbon neutral, the carbon dioxide generated by burning BDF, is not counted as global greenhouse gas emission and thus, is considered to be an environment-friendly fuel. In Japan, vegetable fat and oil such as waste oil of households and commercial tempura oil after getting rid of foreign substances and moisture is used mainly as the basic ingredients. BDF is produced fatty acid methyl ester and after the reaction with methanol, which is completely free of catalyzer and glycerin as by-product during the production process. Whether mixed with light oil or 100% BDF, the fuel is used for diesel engine and as alternative fuel to light oil. However, there are concerns that need to be taken into consideration when using BDF. First, fuel consumption is not as good since the amount of heat generated is 10% lower compared to light oil. Second, rubber packing and rubber hose may swell as the dissolving power is strong. Third, when changing from light oil to BDF, clogging may happen in filters due to the peeling of grime inside pipes and fuel tank. Although BDF is a good quality fuel which is similar to light oil, it is necessary to ensure the stable supply and production cost for its sustainability.

III. Actual energy consumption and the estimate of energy consumption reduction effect by type of fishing method

1. Actual energy consumption and expected energy saving effect

The total expected energy saving effect for main type of fishing vessels is estimated by applying the energy saving measures described above and the measures described in chapter Ⅳ(setting reasonable temperature for cold storage in fish hold) and Ⅴ(energy saving technology utilizing LED light). Fuel consumption of the main engine and auxiliary engine was estimated separately for each operational status (navigating, operating and anchorage) of the fishing vessels after which the data on actual operation condition and the condition of fuel consumption were obtained. The total expected energy saving effect is examined for 9 fishing vessels which the reliable data on the amount of fuel consumption and operational status were obtained, shown as follows;

(1) deep-sea tuna long-line fishing vessel (Freeze)

(2) coastal tuna long-line fishing vessel (Fresh)

(3) deep-sea skipjack fishing vessel

(4) offshore trawl fishing vessel

2) Enerhiyang mula sa hangin at araw

Ang paggamit ng natural na enerhiya gaya ng mula sa hangin at araw ay pinagtutuunan ngayon ng pansin. Ang paggamit ng enerhiya mula sa hangin ay hindi lamang upang gamitin ang hangin sa paglalayag kundi pati ang paggamit ng *windmill* para sa pagkarga ng baterya. Ang naimbak na enerhiya ay maaring gamitin upang patakbuhin ang iba pang kasangkapan gaya ng *navigation device*, gamit-panghuli, mga bomba at *rig device*. Sa pagkakabit ng *solar battery* sa mga bangkang pangisda, ang pinakamaiging lugar ay ang *bridge*. Karaniwan, puno na ng kasangkapan ang *bridge* kung kaya't dapat pag-aralan kung paano magdagdag ng iba pang mga bagay gaya ng *windmill*.

3) *Biodiesel fuel*

Ang *Biodiesel fuel* (*BDF*) na karaniwang tumutukoy sa mga langis-panggatong para sa mga makinang *diesel*, ay *biomass energy* gawa sa *biological oil*. Base sa ideya ng *carbon neutral*, ang *carbon dioxide* na galing sa pagsunog ng *BDF* ay hindi binibilang na *global greenhouse gas emission* kung kaya't ito ay itinuturing na *environment-friendly fuel*. Sa *Japan*, ang mantika at langis mula sa gulay ay ginagamit na pangunahing sangkap. Ang *BDF* ay nagmumula sa *fatty acid methyl ester*, pagkatapos ng reaksyon sa *methanol*, na walang *catalyzer*, at *glycerin* na malilikha habang ginagawa. Maging puro man o may halong *light oil* ang *BDF* ay ginagamit sa mga makinang *diesel* o pamalit sa *light oil*. Subalit may mga bagay na kailangang isaalang-alang sa paggamit ng *BDF*. Una, ang konsumo ay hindi kasing-husay dahil ang init na nabubuo ay mas mababa ng 10% kumpara sa *light oil*. Pangalawa, ang balot na goma at tubong yari sa goma ay maaring lumobo sapagkat ang *dissolving power* ay malakas. Pangatlo, kapag nagpalit mula sa *light oil* tungo sa *BDF*, maaring magbara ang mga pansagat gawa ng pagkatunaw ng grasa sa loob ng mga tubo sa tangke ng langis-panggatong. Datapwa't ang *BDF* ay mainam na uri ng panggatong na katulad ng *light oil*, kinakailangang siguruhin ang mapagkukunan at alamin ang gastusin ukol dito.

III. Kasalukuyang konsumo at taya sa epekto ng ng pagbaba ng konsumo ayon sa paraan ng pangingisda

1. Kasalukuyang konsumo at tinatayang tipid sa konsumo

Ang inaasahang kabuuang matitipid na konsumo ay tinataya sa pamamagitan ng pagsasagawa ng mga hakbang na nabanggit sa taas at iba pang nailarawan na sa Kabanata IV (paglalagay sa tamang temperatura sa palamigan o *cold storage* sa taguan ng isda) at V (pagtitipid ng enerhiya gamit and *LED* na ilaw). Ang konsumo ng pangunahing makina at pantulong na makina ay magkahiwalay na tinaya sa ibat-ibang kalagayan (naglalayag, nagingisda, at nakaangkla) ng mga bangkang pangisda, pagkatapos ay kinuha ang mga tala sa kundisyon ng operasyon at konsumo. Ang mga sumusunod na tala ay nakuha sa pamamagitan ng pag-aaral sa katipiran sa konsumo ng 9 na bangkang pangisda;

(1) Pang-malalimang pangawil ng tuna (Ilado)

(2) Pang-malapitang pangawil ng tuna (Sariwa)

(3) Pang-malalimang bangkang pangisda ng tambakol

(4) Pang-malayuang bangkang pang-galadgad

(5) small-sized squid fishing vessel

These vessels are operated as chartered vessels or have been used as chartered vessels in the past of which the data obtained by FRA

(7) small-sized pole-and-line fishing vessel

(8) small-sized trawl fishing vessel

The amount of fuel consumption is measured with a fuel flow meter for these vessels.

(9) large-scale saury square net fishing vessel which were used in the energy saving demonstration project conducted by the Fisheries Agency.

The trial calculation results of energy saving effect for each fishing vessel are shown below. It is noted that the energy saving ratio is an approximate maximum value estimated by applying all possible energy saving measures described in chapter Ⅱ, Ⅳand Ⅴ. It is most important to recognize that the energy saving ratio may vary greatly from vessel to vessel and fishery to fishery, depending on the size, the hull form and also operation mode of fishing vessels, etc.. The fuel saving ratio may be also different whichever energy saving measures may have already been taken for the vessel or not. Therefore the results of examples shown below could be used as a reference.

(1) <u>489-ton class deep-sea tuna long-line fishing vessels (Freeze)</u>

The total fuel consumption was recorded at 849 kl comprising fuel consumption of the main engine (503 kl) and that of the auxiliary engine (346 kl) in one sailing which lasted for 291 days (refer to document 1). However, after all the possible energy saving measures had been conducted, the amount of fuel consumption was estimated at 615 kl indicating an energy saving rate of 28%. For deep-sea tuna long-line fishing vessels which sail for long period of time, it is effective on one hand, to navigate slowly. On the other hand, it is also important to consider that slowing down the speed would increase the amount of fuel consumption of the auxiliary engine since the number of days required for navigating will also increase. It is therefore necessary to decelerate the navigating speed within a range that does not influence the total number of days for fishing operations. Furthermore, the effect could also be expected from improvements in the appendages of the hull, form of the bow and engine parts if there are still rooms for improvement for such parts.

(2) <u>149-ton class coastal tuna long-line fishing vessels (Fresh)</u>

The total fuel consumption was 325 kl which includes the fuel consumption of the main engine at 233 kl and that of the auxiliary engine at 92 kl for 6 sails that lasted 209 days (refer to document 2). After all the possible energy saving measures had been conducted, the amount of fuel consumption was estimated at 231 kl showing an energy saving rate of 29%.

Decelerating the navigation speed is effective for coastal tuna long-line fishing which requires many sails. It is important to consider that slowing down the speed will increase the amount of fuel consumption of the auxiliary engine because the days required for navigating will also increase. It is therefore necessary to decelerate the navigating speed within the range which would not influence the number of days for fishing operation. Furthermore, the effect can be expected by improving the appendages of the hull, form of the bow

(5) Maliliit na bangkang pampusit

Ang mga bangkang ito ay ginamit bilang paupahan at ang mga impormasyon ay kinalap ng *FRA*

(7) Maliliit na mga bangkang pamingwit

(8) Maliliit na mga galadgad

Ang dami ng konsumo ay sinukat sa pamamagitan ng panukat ng daloy ng gatong.

(9) Malalaking bangkang gumagamit ng *saury square net* na ginamit sa proyekto upang ipakita ng Ahensiya ng Pangisdaan ang katipiran sa konsumo.

Makikita sa mga sumusunod ang naging bunga ng mga pagsubok. Mapupunang ang *energy saving ratio* ay ang pinakamataas na tinatayang bilang kung gagamitin ang lahat ng maaring paraan ng pagtitipid ng enerhiya na nabanggit sa Kabanata II, IV at V. Mahalagang unawain na ang *energy saving ratio* o katipiran sa enerhiya ay maaring mag-iba sa bawat bangka at pangisdaan batay sa laki, hugis ng katawan ng bangka at paraan ng pagpapatakbo. Ang *fuel saving ratio* ay maaari ring mag-iba batay sa kung mayroon nang pamamaraan sa pagtitipid ng enerhiya na ginagamit o wala pa. Sa makatuwid, ang mga halimbawang susunod ay magagamit lamang bilang gabay.

(1) <u>489-toneladang pangkat ng pang-malalimang pangawil ng tuna (Ilado)</u>

Naitala ang 849 kl bilang kabuuang konsumo kabilang na ang konsumo ng pangunahing makina (503 kl) at pantulong na makina (346 kl) sa isang paglalayag sa loob ng 291 araw (tignan ang *document 1*). Pagkaraang magamit ang lahat ng uri ng pamamaraan sa pagtitipid ng enerhiya, ang konsumo ay tinatayang 615 kl na nagpapahiwatig ng katipirang nasa 28%. Para sa pang-malalimang pangawil ng tuna na naglalayag sa mahabang panahon, makakatipid kapag naglayag ng dahan-dahan. Sa kabilang banda, marapat na malaman na ang pagbagal ay maaring magpataas ng konsumo ng pantulong na makina dahil sa paglalayag ng mas matagal. Kinakailangang bagalan lamang ang takbo sa saklaw na hindi lubhang makaaapekto sa bilang ng araw ng pangingisda. Dagdag pa rito, ang bunga ay maari ring maasahan kapag pinabuti ang mga parte ng katawan ng bangka, porma ng nguso at mga bahagi ng makina na maari pang mapabuti.

(2) <u>149-toneladang pangkat ng pang-malalimang pangawil ng tuna (Sariwa)</u>

Ang kabuuang konsumo ay 325 kl kabilang na ang 233 kl na konsumo ng pangunahing makina at ang 92 kl para sa pantulong na makina para sa 6 na paglalayag sa loob ng 209 araw (tignan ang *document 2*). Pagkaraang magamit ang lahat ng uri ng pamamaraan sa pagtitipid ng enerhiya, ang konsumo ay tinatayang 231 kl na nagpapahiwatig ng katipirang nasa 29%.

Ang pagbagal ng takbo ay epektibo sa mga pangmalapitang pangawil ng tuna na naglalayag ng maraming beses. Marapat na malaman na ang pagbagal ay maaring magpataas ng konsumo ng pantulong na makina dahil sa paglalayag ng mas matagal. Kinakailangang bagalan lamang ang takbo sa paraang hindi lubhang makaaapekto sa bilang ng araw ng and engine parts if there are still rooms for improvement of such parts.

(3) 499-ton class deep-sea skipjack fishing vessels (Freeze)

Total fuel consumption was 853 kl: fuel consumption of main engine 507 kl and that of auxiliary engine 345 kl for 4 sails lasting 250 days (refer to document 3). Assuming all possible energy saving measures had been conducted, the amount of fuel consumption would be estimated at 654 kl and an energy saving rate of 23%.

Decelerating the navigation speed is effective for deep-sea skipjack fishing vessels navigating for a long period of time. However, it is important to consider that slowing down the speed will increase the amount of fuel consumption of the auxiliary engine since the number of days required for navigating will also increase. It is therefore, necessary to decelerate the navigation speed within the range that would not influence the total number of days for the fishery. Furthermore, the effect can also be expected by improving the appendages of the hull, form of the bow and engine parts where improvements of the parts are still possible.

(4) 349-ton class large-scale purse seine fishing vessels

Total fuel consumption was 1,756 kl, comprising fuel consumption of the main engine at 1,112 kl and that of 3 auxiliary engines 644 kl for 5 sails lasting 258 days (refer to document 4). Assuming all possible energy saving measures had been conducted, the amount of fuel consumption would be estimated at 1,497 kl and an energy saving rate of 15%.

Decelerating the navigation speed is effective for large-scale purse seine fishing vessels which navigate for long period of time. However, it is important to consider that slowing down the speed will increase the amount of fuel consumption of the auxiliary engine because the number days required for navigation will also increase. It is therefore, necessary to decelerate the navigating speed within the range that will not influence the number of days for the fishery. Furthermore, the effect can be expected by improving the appendages of the hull, form of the bow and engine parts that could still be improved.

(5) 60-ton class offshore pair trawl fishing vessels

The total fuel consumption was 394 kl, of which the fuel consumption of 2 main engines is 341 kl and that of the auxiliary engine is 53 kl for 29 sails lasting 136 days (refer to document 5). When all possible energy saving measures had been conducted, the amount of fuel consumption would be estimated at 257 kl indicating an energy saving rate of 35%. For trawl fishing vessels, using low-resistance fishing gear is effective. However, it should be considered that trawling with the fuel handle of the engine in the same position as with the conventional fishing gear will make the vessel navigate faster and eventually the energy saving effect will be less. Furthermore, the effect can be expected by improving the appendages of the hull, form of the bow and engine parts that could still be improved.

(6) 133-ton class saury square net fishing vessel (only for the operation of saury fishing)

The total fuel consumption was 324 kl of which the fuel consumption of the main engine is 192 kl and that of the auxiliary engine is 132 kl for 103 sails lasting 136 days (refer to document 6). After all possible energy saving measures had been conducted, the amount of fuel consumption would be estimated at 195 kl and an energy saving rate of 40%. In saury square net fishing, using LED fishing light is a good way of saving energy. Changing from pangingisda. Dagdag pa rito, ang bunga ay maari ring maasahan kapag pinabuti ang mga parte ng katawan ng bangka, porma ng nguso at mga bahagi ng makina kung maari pa itong mapabuti.

(3) 499- toneladang pangkat ng pang-malalimang pangisda ng tambakol (Ilado)

Ang kabuuang konsumo ay 853 kl: ang konsumo ng pangunahing makina ay 507 kl at sa pantulong ay 345 kl para sa 4 na paglalayag sa loob ng 250 araw (tignan ang *document 3*). Pagkaraang magamit ang lahat ng uri ng pamamaraan sa pagtitipid ng enerhiya, ang konsumo ay tinatayang 654 kl na nagpapahiwatig ng katipirang nasa 23%.

Ang pagbagal ng takbo ay epektibo sa mga pang-malalimang pangisda ng tambakol na naglalayag ng mahabang panahon. Marapat na malaman na ang pagbagal ay maaring magpataas ng konsumo ng pantulong na makina dahil sa paglalayag ng mas matagal. Kinakailangang bagalan lamang ang takbo sa saklaw na hindi lubhang makakaapekto sa bilang ng araw ng pangingisda. Dagdag pa rito, ang bunga ay maari ring maasahan kapag pinabuti ang mga parte ng katawan ng bangka, porma ng nguso at mga bahagi ng makina kung maari pa itong mapabuti.

(4) 349- toneladang pangkat ng malalaking bangkang pangulong

Ang kabuuang konsumo ay nasa 1,756 kl, na binubuo ng 1,112 kl para sa pangunahing makina at 644 kl para sa 3 pantulong na makina sa 5 beses ng paglalayag na tumagal ng 258 araw (tingnan ang *document 4*). Pagkaraang magamit ang lahat ng uri ng pamamaraan sa pagtitipid ng enerhiya, ang konsumo ay tinatayang 1,497 kl na nagpapahiwatig ng katipirang nasa 15%.

Ang pagbagal ng takbo ay epektibo sa mga malalaking bangkang pangulong na naglalayag ng mahabang panahon. Marapat na malaman na ang pagbagal ay maaring magpataas ng konsumo ng pantulong na makina dahil sa paglalayag ng mas matagal. Kinakailangang bagalan lamang ang takbo sa saklaw na hindi lubhang makakaapekto sa bilang ng araw ng pangingisda. Dagdag pa rito, ang bunga ay maari ring maasahan kapag pinabuti ang mga parte ng katawan ng bangka, porma ng nguso at mga bahagi ng makina kung maari pa itong mapabuti.

(5) 60- toneladang pangkat ng pang-malayuang pares ng galadgad

Ang kabuuang konsumo ay nasa 394 kl, kung saan ang konsumo ng 2 pangunahing makina ay 341 kl at 53 kl para sa pantulong na makina para sa 29 beses ng paglalayag na tumagal ng 136 araw (tignan ang *document 5*). Pagkaraang magamit ang lahat ng uri ng pamamaraan sa pagtitipid ng enerhiya, ang konsumo ay tinatayang 257 kl na nagpapahayag ng katipirang nasa 35%. Para sa mga galadgad, ang pagamit ng magaang-laban na gamit-pangisda ay mahusay. Subalit dapat na isipin na ang paggamit ng galadgad habang tumatakbo sa kaparehas na bilis habang gamit ang karaniwang gamit-pangisda ay magbubunga sa mas mabilis na paglalayag kaysa sa kinakailangan, kung saan mas kaunti ang matitipid na enerhiya. Dagdag pa rito, ang bunga ay maari ring maasahan kapag pinabuti ang mga parte ng katawan ng bangka, porma ng nguso at mga bahagi ng makina na maari pang mapabuti.

(6) 133- toneladang pangkat ng bangkang gamit para sa *saury square net* fishing (para sa pangingisda lamang ng saury)

Ang kabuuang konsumo ay nasa 324 kl kung saan ang konsumo ng pangunahing makina ay 192 kl at 132 kl sa pantulong na makina para sa 103 beses ng paglalayag sa loob ng 136 araw (tignan ang *document 6*). Pagkaraang magamit ang lahat ng uri ng pamamaraan sa incandescent lamp and metal halide lamp for a total of 628 kW to LED fishing light 86 kW, with the electricity on board remains at the same amount, about 71% of energy is expected to be saved during the fishing operation. Certain amount of effect can be expected by improving the appendages of the hull, form of the bow and engine parts in case the navigation speed can be decelerated or in case there is room for improving such parts.

(7) <u>14-ton class small-sized squid fishing vessels</u>

The fuel consumption of the main engine was 85 kl for the total annual operation of 3,144 hours (refer to document 7). Assuming that all the possible energy saving measures had been conducted, the amount of fuel consumption would be estimated at 59 kl indicating an energy saving rate of 31%. In squid fishing, using LED fishing light is a good means of saving energy. Changing the metal halide lamp of 628 kW to LED fishing light of 45 kW and metal halide lamp of 45 kW, and with the electricity on board remains the same amount, about 34% of energy is expected to be saved during the operation.

(8) <u>7-ton class small-sized pole-and-line fishing vessels</u>

Fuel consumption of the main engine is 32 kl for the annual operation of 1,674 hours (refer to document 8). Assuming all the possible energy saving measures had been conducted, the amount of fuel consumption would be estimated at 26 kl and an energy saving rate of 20%. The load factor during inward voyage could be up to about 50% and it would be necessary to decrease the engine power when the old engine is replaced with a new one. This implies that the effect of energy saving is big if the engine is replaced by another one with proper power.

(9) <u>9.9-ton class small-sized trawl fishing vessels</u>

The fuel consumption of the main engine is 65 kl for the annual operation of 2,395 hours (refer to document 9). Assuming all the possible energy saving measures had been conducted, the amount of fuel consumption would be estimated at 61 kl and energy saving rate is 7%. Decelerating the speed during operation is not an effective way to save energy for small-sized trawl fishing vessels as the fishing grounds are close. Reviewing the composition of the fishing gear to reduce the resistance to the extent possible, could save energy during the operation. As for small-sized coastal fishing vessels, 5%-10% of energy saving can be expected by replacing the engine which had been used for a long time to a new one, this approach may not be profitable if the sole goal is energy saving.

2. Evaluation of existing energy saving technology and the challenges for the future

The abovementioned cases show the estimated energy saving effect and the actual consumption condition by size and type of fishing vessels. As the results, it is clear that the operational measures such as the slowing down the speed could be most effective means of saving energy. In addition, it is important to note that operational measures will required no any new equipment or more cost, that is, cost-free. However, it is possible that people onsite are not aware of the fact and such measures have been implemented. In the future, it is necessary to actively promote such measures to the fishing industry onsite through meetings and consultations with stake holders.

Nevertheless, it should also be understood that the necessary cost of energy saving technology concerning fishing method, fishing gear, and remodeling of engine and hull may vary greatly depending on the specifications of fishing vessels, and the expected effect which will also vary greatly depending on each vessel and the type of fishery. As the pagtitipid ng enerhiya, ang konsumo ay tinatayang 195 kl na nagpapahayag ng katipirang nasa 40%. Sa *saury square net* fishing, ang paggamit ng *LED* na ilaw-pangisda ay mabisang paraan upang makatipid ng enerhiya. Kapag pinalitan ang ang mga bumbilyang *incandescent* at *metal halide*, na nagtataglay ng kabuuang 628 kW, ng *LED* na mayroon lamang 86 kW, aabot sa 71% ang inaasahang matitipid na enerhiya habang nangingisda. Mapapahusay pa ang pagtitipid kapag pinabuti ang mga parte ng katawan ng bangka, porma ng nguso at mga bahagi ng makinang maari pang mapabuti.

(7) <u>14-toneladang pangkat ng maliliit na bangkang pampusit</u>

Ang kabuuang konsumo ng pangunahing makina ay 85 kl sa taunang paggamit na tumagal ng 3,144 oras (tignan ang *document 7*). Pagkaraang magamit ang lahat ng uri ng pamamaraan sa pagtitipid ng enerhiya, ang konsumo ay tinatayang 59 kl na nagpapahayag ng katipirang nasa 31%. Sa pangingisda ng pusit, ang paggamit ng *LED* ay mahusay na paraan upang makatipid ng enerhiya. Kapag pinalitan ang ang mga bumbilyang *metal halide* na may 628 kW ng *LED* at *metal halide* na may 45 kW, aabot sa 34% ang inaasahang matitipid na enerhiya habang nangingisda.

(8) <u>7- toneladang pangkat ng maliliit na bangkang pamingwit</u>

Ang konsumo ng pangunahing makina ay 32 kl para sa taunang paggamit na tumatagal ng 1,674 oras (tignan ang *document 8*). Pagkaraang magamit ang lahat ng uri ng pamamaraan sa pagtitipid ng enerhiya, ang konsumo ay tinatayang 26 kl na nagpapahayag ng katipirang nasa 20%. Ang *load factor* sa paglayag sa laot ay aabot sa 50% at kailangang hinaan ang lakas ng makina kapag pinalitan ng bago ang lumang makina. Mangangahulugang malaki ang matitipid na enerhiya kapag ang makina ay napalitan ng may tamang lakas.

(9) <u>9.9- toneladang pangkat ng maliliit na galadgad</u>

Ang konsumo ng pangunahing makina ay 65 kl sa taunang paggamit na tumagal ng 2,395 oras (tignan ang *document 9*). Pagkaraang magamit ang lahat ng uri ng pamamaraan sa pagtitipid ng enerhiya, ang konsumo ay tinatayang 61 kl, katumbas ng katipirang 7%. Ang pagbagal ng takbo habang nagingisda ay hindi mabisang paraan ng pagtitipid ng enerhiya para sa mga maliliit na bangkang gumagamit ng galadgad. Mas makabubuting pag-aralan ang yari ng galadgad upang mabawasan ang paglaban na magiging daan sa pagtitipid ng enerhiya. Sa mga maliliit na bangkang pangisda, 5%-10% ang matitipid sa enerhiya kung papalitan ang lumang makina subalit hindi ito magdudulot ng dagdag na kita.

2. Pagtasa sa mga umiiral na teknolohiya sa pagtitipid ng enerhiya at ang mga hamon sa hinaharap

Ang mga nabanggit sa itaas ay nagpapakita ng tinatayang katipiran sa enerhiya at ang tunay na kalagayan ng konsumo batay sa laki at uri ng bangkang pangisda. Base sa mga resulta, maliwanag na ang pagpapatakbo ng mabagal ay pinakamabisang paraan ng pagtitipid ng enerhiya. Dagdag pa rito, ang naturang paraan ay hindi nangangailangan ng bagong kagamitan o gastusin. Samantala, maaring hindi pa batid ng mga taong dapat magsagawa nito kung nasubukan na ang ganitong mga pamamaraan. Sa hinaharap, price of fuel oil continues to fluctuate, it would be difficult to uniformly estimate the cost-benefit performance of introducing energy saving technology, making it also difficult to extend and apply the technology. In the future, it would be necessary to work towards compiling more cases through the research conducted by FRA and projects implemented by the Fisheries Agency. Moreover, it would also be necessary to draft a guideline on how to determine the cost-benefit performance and the suitability among the different technologies based on the results of the case studies. Moreover, most of the existing technologies that have been compiled are applicable to fishing vessels operating in offshore and in the deep-seas, but such measures are not adequate for small-sized coastal fishing vessels except for the operational software aspect. Urgent consideration concerning countermeasures for small-sized coastal fishing vessels is therefore necessary in the future. Basically, it would be more efficient to search fish through group operations and also utilizing satellite information as well as shortening the navigation time and distance in order to reduce the energy consumption per fish catch. Forming small groups of fishing vessels to do purse seine fishing would also be important. This issue should be addressed in a comprehensive manner not only in terms of saving energy and saving on costs but also in improving the safety, working environment of crews and profitability in order to change the structure of capture fisheries.

Furthermore, in order to introduce specific energy saving technology, fisheries engineering (bridging the gap between fishermen and experts on research and development) and respective technical instructions and advice are necessary. Therefore, in addition to the suggested meetings in the fishing communities onsite as mentioned earlier, there is a need for concerned research institutes, administrative departments, shipyards, fishing gear manufacturers, and fishing organizations enhance cooperation and establish a framework to support fisheries engineering including the development of human resources.

IV. Setting proper temperature for cold storage in fishery warehouse

In fishery industry, especially in fishery product processing industry, cold storage is important in order to manage hygiene control of fishery products, maintain freshness, control quality, keep the high quality of products and keep it high value-added. It has been considered that the lower the storage temperature is, the more effective it is to keep the quality high. However, keeping the temperature low consumes a lot of energy and this also increases the burden for the people who are involved with the process of production to processing and marketing. Frozen tuna in particular is treated completely different from other frozen fish as it is considered an extremely product. Immediately after being caught, tuna are rapidly frozen (-55 degrees) and the temperature of storage of products is extremely low (under -50 degrees) as well, therefore a great deal of energy is consumed in the fishery warehouse on the vessel and in onshore facilities. It is necessary to understand accurately the relation between the storage temperature of fishery products and quality preservation and reconsider proper storage temperature of fishery products in order to promote energy saving.

1. Refrigerant gas of refrigerating appliance

Domestic supplied amount of sashimi tuna in 2006 was 408,000 tons and among them, frozen products accounted kinakailangang aktibong ipabatid ang mga kaalamang ito sa industriya ng pangisdaan sa pamamagitan ng mga pagpupulong at pakikisalamuha sa mga dapat makinabang.

Magpasaganunpaman, kailangang maunawaan na ang halaga ng pagtitipid ng enerhiya batay sa paraan ng pangingisda, gamit-pangisda, pagsasaayos ng makina at katawan ng bangka ay mag-iiba ayon sa mga detalye ng bangkang pangisda at uri ng pangisdaan. Habang paiba-iba ang presyo ng langis-panggatong, magiging mahirap ang pagtaya sa *cost-benefit performance* ng pagmumungkahi ng teknolohiya sa pagtitipid ng enerhiya, maging ang mismong paggamit nito. Sa hinaharap, kakailanganing magtulungan upang makapag-ipon ng dagdag na mga kaso sa pamamagitan ng pagsasaliksik na ginawa ng *FRA* at mga proyektong isinakatuparan ng Ahensiya ng Pangisdaan. Kakailanganin ding gumawa ng mga panuntunan kung paano masisiguro ang *cost-benefit performance* at ang kaangkupan ng ibat-ibang mga teknolohiya base sa bunga ng mga pag-aaral. Samantala, karamihan sa mga umiiral na teknolohiyang nakalap ay maaaring gamitin sa mga pang-malaliman at pang-malayuang bangkang pangisda, ngunit ang iba ay hindi angkop para sa mga maliliit na bangkang pangisda. Kailangan ding bigyang pansin ang pangangailangan ng mga maliliit na bangkang pangisda sa hinaharap. Mas mahusay ang paghahanap ng mapangingisdaan kung gagamit ng grupo, impormasyong galing sa *satellite* na makababawas sa oras ng paglalakbay at layo ng lalakbayin, nang sa gayon ay mabawasan ang gamit na enerhiya kada isdang huli. Ang pagbuo ng maliliit na grupo ng pangulong ay kailangan din. Ang usaping ito ay dapat tugunan sa komprehensibong paraan hindi lamang sa larangan ng pagtitipid ng enerhiya kundi pati na rin sa pagpapataas ng antas ng kaligtasan, kalagayan ng gawaan at kawani, at karagdagang kita upang mabago ang kalagayan ng industriya.

Dagdag pa rito, upang maisulong ang teknolohiya sa pagtitipid ng enerhiya, ang *fisheries engineering* (pagtulay sa agwat ng kaalaman ng mga mangingisda at mga bihasa) at mga teknikal na kautusan at mungkahi ay kinakailangan. Sa makatuwid, maliban sa mga solusyong nabanggit, nararapat na palakasin ang pagtutulungan ng mga ahensiyang nagsasaliksik, mga nagpapatupad, pagawaan ng bangka, pagawaan ng mga gamit-pangisda at mga samahan upang makapagtalaga ng balangkas na tutulong sa *fisheries engineering*, kalakip na ang pagpapalakas ng yaman-tao.

IV. Pagtatakda ng tamang temperatura para sa palamigan (*cold storage*) sa bahay-imbakan ng isda

Sa industriya ng pangisdaan, partikular na ang pagpoproseso ng isda, mahalaga ang palamigan upang mapangalagaan ang kalinisan, kasariwaan, kalidad at mapanatili ang mataas na *value-added*. Napatunayan na habang mas malamig ay mas mabisang napapanatili ang mataas na kalidad ng produkto. Subalit ang mababang temperatura ay kumukunsumo ng mataas na enerhiya at nagpapahirap sa galaw ng mga kawaning namamahala. Halimbawa, ang iladong tuna ay mas binibigyang pansin kumpara sa iba pang uri ng isda. Kaagad pagkatapos mahuli, ang tuna ay pinalalamig (-55 *degrees*) at ang temperatura ng palamigan ay lubhang mababa (under -50 *degrees*), sa makatuwid, napakalaking enerhiya ang nagagamit sa bahay-imbakan sa bangka at sa mga pasilidad sa daungan. Mahalagang maunawaan ang ugnayan ng temperatura sa pagpapalamig ng uri ng produktong isda at ng pagpapanatili ng kalidad nang sa gayon ay maipatupad ang pagtitipid ng enerhiya habang inaabot ang kinakailangang temperatura.

1. *Refrigerant gas* ng kasangkapang pampalamig

Ang dami ng pang-*sashimi* na tuna sa bansa noong 2006 ay 408,000 tonelada, at kabilang for 291,000 ton. (Domestic: 123,00 tons, Imported: 168,000 tons) (2006; Distribution Statistics of fishery products/ Japan Trade Statistics). Extreme low temperature storage of Tunas was supported by designated chlorofluorocarbon (R22) which was used as refrigerant gas of refrigerating appliance. However, regulation for chlorofluorocarbon (R22) has started according to Montreal Protocol due to global environmental issues, and its production should be abolished totally by 2012. Ozone depletion potential of alternative for chlorofluorocarbon (R134a, R404A etc.) is 0, yet it has a high global warming potential. Therefore, there is emission constraint against it. Natural refrigerant (NH_3, CO_2) refrigerating appliance is more expensive than the conventional products making it difficult to control temperature under -45 degree with about the same cost as fluorocarbon refrigerant. Therefore tackling the issue is urgent as currently it is common to store under -50 degrees on fishing vessels and in the onshore facilities.

2. Processing and storage of tuna after being caught

Tuna which were caught by deep-sea tuna long-line fishery will be processed by removing nerves, blood, gut and head , and after removal, rapid freezing will be done for 36-48 hours (air blast freezing) which will make it frozen products by making the temperature of the center of fish under -55 degrees. Many fishing vessels store frozen tuna in fishery warehouse in extremely low temperature (under -50 degrees) which is as cold as the temperature inside the fishery warehouse of carrying vessels and freezing containers. The time required from fishing of tuna until catching landing is shorted 6months, generally within 12 months and in rare cases it may take as long as 18 months.

After catch landing, fish will go through a various processing and distribution routes and will reach the consumers. In general, the storage period in onshore refrigerators is 2 to 6 months for lean fish such as Thunnus obesus and Thunnus albacares which are carried in all year round and 12 months for fish with a lot of fat such as southern bluefin tuna and bluefin tuna as they are sold until next season. Both of them are stored in general under -50 degrees in extreme low-temperature refrigerator. Furthermore, cold storage period for extreme low-temperature refrigerator near consuming region including the storage period for fish with a lot of fat is about 2 months.

As just described, frozen tuna are storage under -50 degrees without temperature change inside the fishery warehouse on the vessel, during transport by carrying vessel and containers and in onshore. However the temperature of fish body may change when being exposed to outdoor air such as when moving from fishing vessels to carrying vessels, during transfer from carrying vessels to extreme low-temperature refrigerator in onshore, when being on the market, when it is being processed , during transfer and at the time of sale. According to the survey by FRA, if the fish is exposed to outdoor air of 18 degrees for 3 hours when being on the market, it is confirmed that the temperature of the center of fish increases about 17 degrees.

3. Energy saving effect after turning up the storage temperature

According to preliminary calculation by FRA, raising the temperature of fishery warehouse to store frozen tuna from extreme low-temperature -50 degrees to -40 degrees, in terms of fuel 7% of annual consumption is expected to dito, ang iladong produkto ay humantong sa 291,000 tonelada. (Pambansa: 123,00 tonelada, Inangkat mula sa ibang bansa: 168,000 tonelada) (2006; *Distribution Statistics of fishery products/ Japan Trade Statistics*). Ang lubhang mababang temperatura sa imbakan ng tuna ay ginamitan ng *chlorofluorocarbon* (*R22*) na siyang ginamit na *refrigerant gas* ng kasangkapang pampalamig. Samantala, ang panukala sa paggamit ng *chlorofluorocarbon* (*R22*) ay nagsimula sa *Montreal Protocol* dahil sa pandaigdigang usapin sa kapaligiran, ang paggamit dito ay dapat na tuluyang matigil sa 2012. Ang *ozone depletion potential* ng panghalili sa *chlorofluorocarbon* (*R134a, R404A etc.*) ay 0, pero nagtataglay ito ng mataas na *global warming potential*. Sa makatuwid, mayroong *emission constraint* laban dito. Ang natural na *refrigerant* (NH_3, CO_2) para sa kasangkapang pampalamig ay mas mahal kumpara sa karaniwang produkto kung kaya't mahirap magpanatili ng temperaturang mas mababa kaysa -45 *degrees* sa kahalintulad na halaga ng *fluorocarbon refrigerant*. Sa makatuwid, mahalagang madaliin ang pagharap sa naturang usapin sapagkat karaniwang kailangan ang pag-iimbak ng isda sa temperaturang mas mababa sa 50 *degrees* sa mga bangka at pasilidad sa daungan.

2. Pagpoproseso at pag-iimbak ng tuna pagkaraang mahuli

Ang mga tuna na nahuli sa pamamagitan ng kawil ay ipoproseso sa pamamagitan ng pagtanggal ng ugat, dugo, laman-loob at ulo pagkatapos ay palalamigin ng mabilisan sa loob ng 36-48 oras (*air blast freezing*) upang maging ilado kung saan ang temperatura sa gitna ng isda ay mas mababa kaysa -55 *degrees*. Marami sa mga bangkang pangisda ang nag-iimbak ng tuna sa mga bahay-imbakan sa loob ng napakababang temperatura (mas mababa sa -50 *degrees*) na kasinlamig ng temperatura sa imbakan ng bangka. Ang panahong kinakailangan mula sa paghuli ng tuna hanggang sa pagbaba sa pamilihan ay mula sa 6 na buwan, ang karaniwan ay 12 na buwan at kung minsan ay umaabot ng 18 na buwan.

Pagkatapos maibaba, ang isda ay dadaan sa ibat-ibang proseso at ruta ng pamamahagi hanggang makarating sa mga mamimili. Sa pangkalahatan, ang pagkakaimbak sa mga palamigan ay tatagal ng 2 hanggang 6 na buwan para sa mga isdang walang masyadong taba gaya ng *Thunnus obesus* at *Thunnus albacores* na isinasagawa buong taon at 12 na buwan naman para sa mga isdang maraming taba gaya ng *southern bluefin tuna* at *bluefin tuna* sapagkat ang mga ito ay ipagbibili naman sa mga darating na buwan. Ang mga ito ay karaniwang iniimbak sa -50 *degrees* sa palamigan. Dagdag pa rito, ang panahon ng pag-iimbak sa loob ng napakababang temperatura sa loob ng palamigan malapit sa mga lugar na pagbebentahan, pati na ang pag-iimbak ng mga isdang maraming taba ay umaabot ng 2 na buwan.

Kagaya ng nabanggit, ang iladong tuna ay iniimbak sa -50 *degrees* sa loob ng bangka, maging sa mga bahay-imbakan. Subalit maaaring magbago ang temperatura ng isda habang inililipat dahil sa pagkalantad sa hangin, halimbawa sa paglipat sa bangkang magdadala sa pamilihan at habang inilalako. Ayon sa pagsisiyasat ng *FRA*, kapag ang isda ay nalantad sa hangin na may 18 *degrees* sa loob ng 3 oras, ang temperatura nito ay tataas ng halos 17 *degrees*.

3. Epekto ng pagtitipid ng enerhiya pagkaraang tumaas ang pang-imbak na temperatura

Ayon sa taya ng *FRA*, ang pagpapataas ng temperatura sa bahay-imbakan mula sa -50 *degrees* tungo sa -40 *degrees*, ay magpapababa ng 7% sa taunang konsumo. Ang be reduced. Average fuel consumption rate per 1 sail day of deep-sea tuna long-line fishing vessels is 3.0 kl. Assuming that annual operation period is 320 days and the total number of vessels is 360 (As of May, 1997), annual fuel consumption rate by deep-sea tuna long-line fishing vessels would be 345,000 kl. If it will be possible to raise the temperature of fishery warehouse from conventional extreme low-temperature (-50 degrees) to -40 degrees to ~ 45 degrees, 15~40 % of power consumption can be reduced. Furthermore, general packing material can be used instead of special packing material for extreme low-temperature and this may lead to cost saving.

4. Agenda concerning frozen storage of tuna to be examined in the future

Frozen tuna are stored in extreme low-temperature. (Under -50 degrees) However, scientific basis concerning the relation between quality and the storage temperature is not clear. Deep-sea tuna long-line fishing vessels in particular received requests from stake holders to differentiate it from other fishing vessels which deal with frozen products as if it is competing with other fishing vessels. Using extreme low-temperature in cold storage became widespread on a parallel with the increase in performance of cooling system due to the use of fluorocarbon refrigerant. According to experimental research and literature in the past, there is no scientific knowledge which say that cold storage in the temperature lower than -40 degrees is necessary in order to ensure quality when storing tuna for a long period of time.

According to quality assurance period by temperature during onshore storage of tuna frozen on vessel (Quality assurance period judging from the degree of discoloration of tuna meat) in the collection of papers by Japan Society of Refrigerating (Vol. 1 No.1-2,1984), quality assurance limit of Thunnus obesus which is a typical lean fish used for sashimi is more than 17 months when stored under -40 degrees judging from metmyoglobin condition which is an index of browning of fish meat. This indicates that if tuna which are frozen rapidly on the vessel as usual are stored under -40 degrees in fishery warehouse and in onshore facility, the quality (color) is controlled. As there is no knowledge about the relation between quality preservation and cold storage temperature of bluefin tuna and other fish which have a lot of fat and the effect to quality when storing for a long period of time which exceeds the usual term from fish catch until consumption. (Generally about 1 year and half), there is a need to examine more in the future. Currently, thanks to the progress of equipment and management technology, it is possible to store in nearly constant temperature in the fishery warehouses of Japanese fishing vessels and inside onshore refrigerators. However, when frozen tuna are exposed to outdoor air such as when transshipment, catch landing and being sold in the market, the temperature rises. In order to accurately understand the influence which temperature change of frozen tuna through production to consumption may have over the quality and condition, it is necessary to make a temperature measurement carefully in each process. Also, it is important to get evaluation from intermediary and other stake holders about extreme low-temperature stored tuna and frozen tuna which were stored about -40 degrees on vessels and considers the energy saving effects due to the difference of store temperature in fishery warehouses.

We need to work on the research concerning the influence on quality by different condition such as freeze speed, difference of cold storage temperature, fat content, temperature change and long term storage, using degeneration karaniwang konsumo bawat araw ng paglalayag ng mga pang-malalimang bangkang pangawil ng tuna ay 3.0 kl. Halimbawang ang taunang pangingisda ay 320 at ang bilang ng mga bangka ay 360 (hanggang Mayo, 1997), ang taunang kaubuuang konsumo ay magiging 345,000 kl. Kung maaring itaas ang temperatura ng mga bahay-imbakan mula sa napakababang antas (-50 *degrees*) tungo sa -40 *degrees* o hindi kaya'y -45 *degrees*, 15~40 % ang ibababa ng konsumo. Dagdag pa rito, maaring gumamit ng pangkaraniwang pambalot sa halip na mamahaling pambalot upang makatipid kahit na mag-iimbak sa napakababang temperatura.

4. Mga usapin sa hinaharap ukol sa iladong tuna

Ang iladong tuna ay iniimbak gamit ang napakababang temperatura. (mas mababa kaysa -50 *degrees*) Subalit ang pang-agham na batayan sa kaugnayan ng kalidad at lamig ng pagkakaimbak ay hindi maliwanag. Ang mga bangkang pangawil ng tuna ay nakakatanggap ng hiling mula sa mga bumibili upang ihiwalay ang huli mula sa mga karaniwang isdang imbak, na wari ay nagpapaligsahan ang mga ito. Ang pag-iimbak sa napakababang temperatura ay naging malawakan mula nang simulan ang paggamit ng *fluorocarbon*. Wala pang maliwanag na pag-aaral na nagsasad na kinakailangan ang pag-iimbak sa loob ng temperaturang mas mababa kaysa -40 *degrees* upang mapanatili ang kalidad ng tuna kung iimbakin sa mahabang panahon.

Ayon sa mga saliksik (*Quality assurance period judging from the degree of discoloration of tuna meat*) na nakalap ng *Japan Society of Refrigerating* (*Vol. 1 No.1-2,1984*), ang *Thunnus obesus* na ginagamit bilang *sashimi* ay dapat hindi tumagal ng higit sa 17 buwan kapag naimbak sa temperaturang mas mababa kaysa sa -40 *degrees* base sa kundisyon ng *metmyoglobin* na siyang talatuntunan ng pagbabago ng kulay ng laman ng isda. Ito ay nagpapahiwatig na kapag ang tuna ay mabilis na napalamig sa loob ng bangka sa lamig na mas mababa kaysa sa -40 *degrees* ang kalidad (kulay) ay mapapangalagaan. Dahil sa kawalan ng pag-aaral tungkol sa ugnayan ng kalidad at lamig ng pagkakaimbak ng *bluefin tuna* at iba pang isdang nagtataglay ng maraming taba na karaniwang naiimbak ng matagal (halos 1 at kalahating taon), kailangang pagtuunan ito ng pansin sa hinaharap. Salamat sa pag-unlad ng teknolohiya, maari nang makapag-imbak sa panayang (*constant*) temperatura sa loob ng mga bahay-imbakan sa loob ng mga bangkang pangisda ng *Japan* at maging sa mga palamigan sa daungan. Subalit ang mga iladong tuna ay nalalantad pa rin sa hangin habang ito ay inililipat at inilalako. Upang higit pang maunawaan ang epekto ng mga pagbabago ng temperatura ng isda mula sa pagkahuli hanggang makarating sa mamimili, kailangang sukating mabuti ang temperatura sa bawat paglipat. Kailangan ding malaman ang mga pagtasa ng mga mangangalakal tungkol sa mga naimbak na tuna sa lamig na mas mababa kaysa -40 *degrees* sa loob ng mga bangka at ang katumbas na katipiran sa enerhiya. Kailangan pa ang pagsasaliksik tungkol sa epekto sa kalidad ng bilis ng pagpapalamig, temperatura, kargang taba, at haba ng pagkaka-imbak sa pagsusuri ng *degeneration of protein*, *ice crystal formation*, *lipid oxidation* at *metmyoglobin condition* of protein, ice crystal formation, lipid oxidation and metmyoglobin condition as index in order to understand the relation between quality and cold storage temperature of frozen tuna. Also, frozen tuna for sashimi from the point of domestic transaction volume is broadly divided into 1) Medium size Thunnus obesus and Thunnus albacares which are dealt in mass merchandiser markets 2) Large scale Thunnus obesus which is typical lean fish 3) bluefin tuna and southern bluefin tuna which have high fat content, therefore it is necessary to narrow down the type of fish we should start research on.

In promoting the development research of temperature control method regarding proper storage of frozen tuna, it is important to present the result quickly and clearly not only to fishery operators but also frozen tuna handling business operators (processing, refrigerating and transporting) and encourage self-help efforts of the industry towards improvement of system in production and distribution and cost saving. Not only tuna, but the frozen products that deep-sea skipjack long-line fishing vessels have caught (skipjack, B1 products of albacore tuna) are also stored in extreme low-temperature of under -50 degrees on the vessel and onshore as well as tuna. There is also a need to clarify the relation between quality and cold storage temperature and develop a proper cold storage method.

Frozen products of neon flying squids are, as requested by people concerned with the market, stored in fishery warehouse which is -35 degrees on vessel, and are landed. However, they are stored in refrigerators under -20 degrees on land. Therefore, it is needed to consider optimum temperature zone for storage from the point of quality preservation and energy saving.

V. Energy saving technology utilizing LED

1. Environment surrounding fishery using lights

Among the fisheries which are operated using lights, squid fishing and saury square net fishing are conducted utilizing a fish collecting lamp which uses a large amount of light. Electricity is supplied by setting substantial auxiliary machines (by main engine for some small size vessels) due to the usage of fish colleting lamp. A large amount of fossil fuel (mainly heavy oil A) is used to drive auxiliary machines. As fishing industry is suffering financially these days, cost saving is an urgent problem. In order to save fuel cost by controlling consumed power used for fish collecting lamp, LED fish collecting lamp (light-emitting diode) were introduced for as lamps on board and underwater lamps in saury square net fishing and purse seine fishing. Metal halide which is a mainstream light source of fish collecting lamp contains mercury inside its bulb, therefore there is a risk of mercury contamination in case it breaks. As for incandescent lamp, European Union has decided to stop the sale of the incandescent lamps for family use by 2012 and will switch to energy efficient fluorescent lamps. Also, in our country all the incandescent lamps will be switched to energy-saving fluorescent lamps or LED lamps by 2012. Introducing LED fish collecting lamps is also important from the perspective of reducing the global environmental burden.

Moreover, in this text we will use fishing lamps instead of fish collecting lamps for the reason that depending on light, the behavior of the creatures are controlled such as gathering them toward the light source of lamps or moving away from it.

bilang talatuntunan upang maunawaan ang kaugnayan ng lamig sa kalidad ng iladong tuna. Mahalagang piliing mabuti kung saan sisimulan ang pagsasaliksik sapagkat ang mga pang-*sashimi* ay nahahati sa 1) *Medium size Thunnus obesus and Thunnus albacores* na ipinagbibili sa karaniwang pamilihan 2) *Large scale Thunnus obesus* na kabilang sa mga isdang kaunti ang taba 3) *bluefin tuna and southern bluefin tuna* na may mataas na kargang taba.

Mahalagang malaman ang resulta ng pagsasaliksik sa lalong madaling panahon ng mga nangangalakal (*processing, refrigerating* at *transporting*) at himukin ang industriya tungo sa pagpapahusay ng kalakaran sa pangingisda, pamamahagi at pagtitipid. Marami pang ibang uri ng isdang huli ng mga bangkang pangawil (*skipjack*, *B1 products of albacore tuna*) ang iniimbak ng mas mababa sa -50 *degrees* habang nasa loob ng bangka at maging sa mga bahay-imbakan sa dalampasigan. Kailangan ding malaman ang kaugnayan ng kalidad at lamig ng pagkakaimbak upang makagawa ng tamang paraan ng pag-iimbak.

Ang mga iladong produkto gaya ng *neon flying squids* ay hinihiling ng mga mangangalakal na maimbak sa mas mababa kaysa -35 *degrees* sa loob ng bangka bago ibaba. Samantala, ang mga ito ay iniimbak ng mas mababa kaysa -20 *degrees* sa lupa. Sa makatuwid, kailangang alamin ang angkop na temperatura upang makatipid ng enerhiya habang napapangalagaan ang kalidad ng produkto.

V. Pagtitipid ng enerhiya gamit ang *LED*

1. Kasaysayan sa likod ng paggamit ng ilaw-pangingisda

Sa mga paraan ng pangingisda gamit ang ilaw, ang panghuhuli ng pusit at *saury square net* fishing ay isinasagawa gamit ang napakalakas na ilaw. Ang kuryente ay nagmumula sa mga pantulong na makinarya (pangunahing makina para sa mga maliliit na bangka) na ginagamit sa pagpapailaw. Maraming langis-panggatong (karaniwan ay *heavy oil A*) ang nagagamit dito. Sapagkat nagsisimula nang maghirap ang industriya ng pangisdaan, ang pagtitipid ang pangunahing suliranin. Upang makatipid ng konsumo sa pagpapailaw, ang *LED* (*light-emitting diode*) na uri ng ilaw ay iminungkahing gamitin sa pangingisda. Ang *metal halide* na siyang ginagamit na pangunahing ilaw ay nagtataglay ng *mercury* sa loob ng bumbilya nito, kung kaya't mapanganib kapag nabasag ito. Sa karaniwang bumbilya naman, ang *European Union* ay nagdesisyong itigil ang pagbebenta nito bilang pambahay na gamit sa 2012 at lumipat sa mas matipid na *fluorescent lamps*. Maging sa ating bansa, ang mga bumbilya ay papalitan ng mas matipid na *fluorescent lamps* o *LED lamps* sa taong 2012. Ang paggamit ng *LED* bilang ilaw sa pangingisda ay mahalaga rin upang mabawasan ang bigat ng suliraning pangkapaligiran.

2. Background and actual condition of the effort to experimentally introduce LED-fishing lamp

As for saury square net fishing, from 2004 to 2005 private companies have used governmental incentives and in 2006, fishery operators themselves acted as primary actor and used governmental incentives to experimentally introduce it. As for large scale saury square net, 20% to 40% of fuel consumption was reduced by switching incandescent lamps to concentrated light-distribution type LED lights (LED lamps of which light is concentrated in smaller irradiation range) and switching metal halide lamps to diffusion light-distribution type LED lamps (LED lamps of which light is diffused by making the irradiation ranger bigger) and still could obtain about the same result as other fishing vessels of same size,

The same result was shown for small size saury square net fishing vessels as well. Considering those results, both small size and large scale saury square net fishing vessels wholly changed from concentrated light-distribution type LED lamps to diffusion light-distribution type LED lamps and operated experimentally, and as a result it is confirmed that by using diffusion light-distribution type LED about the same amount of fish can be caught. It also indicated downsizing and reduction of auxiliary machines mounted as fishing lamp.

In squid fishing, since 2000 private companies have done experimental introduction utilizing governmental incentives. Most were targeted at sagittated calamari. Experimental operation of changing from metal halide fishing lamps to lights and another experimental operation of using both LED and metal halide fishing lamps were conducted. Concerning the technology using LED as lamps on board, it first started with verification test of using only concentrated light-distribution type LED lamps or using with metal halide lamps. The amount of fish catches declined for both small size and medium size fishing vessels in experimental operation which only used LED and the experimental operation when the usage rate of metal halide lamps is low. Therefore, as well as the exam done to saury square net fishing vessels we have done an experimental operation after changing to diffusion light-distribution type LED as lamps on board. As a result, the same amount of fish as conventional metal halide lamps used for small and medium size squid fishing vessels operated through spring to fall was caught while reducing fuel consumption. However, after fall there are some cases which saw reduction in the amount of fish catches in case only LED lamps are used even if it is diffusion light-distribution type or in case the usage rate of metal halide fishing lamps is low.

On the other hand, as for the utilization technology of LED underwater lamps, according to the daytime operation which targeted at neon flying squid in North pacific ocean by water research institute, about the same amount of fish was caught using LED underwater lamps compared to the operation using conventional metal halide underwater fishing lamps. Currently, the research development for the utilization technology of operation at night time is continuing. Furthermore, since August of 2008, Fisheries institute of Ishikawa prefecture has started test towards utilization technology of LED for sagittated calamari and the characteristics of light source of LED underwater fishing lamps and reaction behavior of sagittated calamari to underwater lamps are becoming clear.

Among large scale purse seine fisheries, fishing lamps are used as vessel on board lamp and underwater lamp for the fishing vessels which are operated in marine area where it is allowed to light such as East sea, yellow sea and

2. Pagsubok at pagmumungkahi sa paggamit ng *LED* na uri ng ilaw sa pangingisda

Sa *saury square net* fishing, mula 2004 hangang 2005, ang mga pribadong kumpanya ay nakinabang sa mga insentibo ng pamahalaan at noong 2006, ang mga mangingisda mismo ay gumamit din ng insentibo mula sa pamahalaan upang subukan ang *LED*. Sa mga malalaking *saury square net*, 20% hanggang 40% ang natipid sa konsumo nang magpalit sa *LED* na ilaw (*LED lamps of which light is concentrated in smaller irradiation range*) at palitan din ang *metal halide lamps* sa *diffusion light-distribution type LED lamps* (*LED lamps of which light is diffused by making the irradiation ranger bigger*).

Katulad na resulta ang ipinakita sa maliliit na bangkang pangisda gamit ang *saury square net*. Masasabing ang malalaki at maliliit na pangkat ng mga mangingisdang gamit ang *saury square net* na lumipat mula sa *concentrated light-distribution type LED lamps* tungo sa *diffusion light-distribution type LED lamps*, bilang pagsasanay, ay magpapatunay na sa pamamagitan ng paggamit ng *light-distribution type LED* halos kasindami rin ng isda ang mahuhuli. Naging daan din ito upang makagamit ng higit na mas maliit na pangalawang kasangkapan sa pagpapailaw.

Sa pangingisda ng pusit, mula 2000, ang mga pribadong kumpanya ay sumubok sa tulong ng insentibo mula sa pamahalaan. Karamihan ay sumentro sa *sagittated calamari*. Ang isang pag-aaral ay nagpalit ng *metal halide* na ilaw sa *LED* at ang ikalawa ay gumamit ng magkahalong *LED* at *metal halide* na mga ilaw-pangingisda. Sa teknolohiyang gamit ang *LED* na ilaw, sinimulan ito sa pagpapatunay gamit ang *concentrated light-distribution type LED* at *metal halide* na mga ilaw. Bumaba ang huli ng mga maliliit at katamtamang laki na mga bangkang pangisda na gumamit ng *LED* lamang at pati na rin noong gumamit ng kaunting *metal halide* na ilaw. Katulad ng pangingisda gamit ang *saury square net,* napatunayang parehas din ang dami ng huli kung gagamit ng *LED* na ilaw mula tag-sibol at tag-lagas. Subalit pagkaraan ng panahon ng tag-lagas, napansing may mga kaso ng pagbaba ng dami ng huli kung ang gamit lamang ay *LED* na ilaw o hindi kaya ay mababa ang paggamit ng *metal halide* na ilaw.

Sa kabilang dako, ang paggamit ng *LED* na ilaw sa ilalim ng tubig sa pangingisda sa araw upang makahuli ng *neon flying squid* sa *North pacific ocean*, na isinagawa ng *Water Research Institute*, ay naghayag na walang pagkakaiba sa dami ng huli sa pagitan ng paggamit ng *LED* at *metal halide* na ilaw. Sa kasalukuyan, patuloy ang pagsasaliksik tungkol sa paggamit ng naturang teknolohiya sa gabi. Dagdag pa rito, mula August ng 2008, ang *Fisheries Institute* ng probinsiya ng *Ishikawa* ay nagsagawa ng pag-aaral tungo sa paggamit ng *LED* para sa *sagittated calamari* kung kaya't ang katangian ng *LED* sa ilalim ng tubig at ang reaksyon ng *sagittated calamari* sa ilaw ay nagsisimula nang mabigyang-linaw.

Ang mga malalaking bangkang pangulong ay gumagamit ng ilaw sa ibabaw at sa ilalim ng

Japan sea. As it uses less light compared to squid fishing and saury square net fishing, the fuel consumption by utilization of fishing lamps is relatively low. Experimental introduction of LED fishing lamp is conducted as governmental incentives project since 2006 and also as incentive project by Nagasaki prefecture. All of these have considered using it as underwater lamp. There is about the same amount of fish catches compared to conventional metal halide lamps and halogen lamps while the fuel reduction effect is also seen. Moreover, there is a report saying that by using characteristic of LED fishing light such as blinking light, it may be possible to collect certain types of fish more effectively. Development and improvement of utilization technology which leads to fish catches more effectively through controlling the behavior of fish school by establishing method of utilization of LED underwater lamps which suits the type of fish and constructing combined utilization technology of underwater lamps and as lamps on board, is expected in the future.

2. Research directions for the future

In fishing using light, there are 4 issues we need to tackle in order to promote introduction of LED. (1) Conduct general verification test of LED throughout the fishing season , (2) Collect necessary data to understand the structure of total energy consumption of fishing vessel, (3) clarify the influence light wavelength, strength and gap of light emission have over the behavior of major marine creatures and develop technology to control fish school by light, (4) Based on the result above, there is a need to promote development of fisheries production system using the characteristic of LED light source.

VI. Estimate emission of greenhouse gases in the fishing industry

With the purpose of making framework for Post Kyoto Protocol, reduction of greenhouse gas emission is required in many sectors. To promote the measures against reduction in fishing industry, it is necessary to evaluate each measurement towards reduction on a regular basis and also to have basic information about it. As for fishing industry, there are examples of estimate amount of carbon dioxide emissions which is calculated by fuel consumption of fishing vessel. However, amount of carbon dioxide emissions of fishing industry as a whole which includes so called postharvest process including fishery production, aquaculture industry, fish processing and distribution are not yet fully understood. In order to reduce greenhouse gas effectively in the future, it is needed to estimate the greenhouse gas emission of fishing industry as a whole from the sample survey and recent statistic data using the information obtained from research data in the past. It is effective to quantitatively evaluate the effect of each reduction measurement and present the effects in a visual manner to reduce greenhouse gas emission in fishing industry. However given the present circumstances, it is unknown how much greenhouse gas is emitted through what kind of action in each process of fish catching, distribution and processing. In considering the measurement for greenhouse gas emission, understanding the greenhouse gas emission in each process from fish catch to consumption is pressing issue. In the future, "Carbon print" which displays the amount of energy being used in production and distribution process, converted into carbon will be introduced. It is effective for consumers to select products which have less carbon emission when selecting. However, as for primary products including fishery tubig habang nagingisda sa *East Sea, Yellow Sea* at *Japan Sea*. Sapagkat mas madalang ang paggamit nito ng ilaw kumpara sa mga nanghuhuli ng pusit at mga gumagamit ng *saury square net* sa pangingisda, ang konsumo ay mas mababa. Ang pagsubok ng *LED* na ilaw ay sinimulan sa bisa ng insentibo mula sa pamahalaan noong 2006 at bilang insentibong proyekto ng probinsiya ng *Nagasaki*. Ang lahat ng ito ay gumamit ng ilaw sa ilalim ng tubig. Halos katulad din ang dami ng huli kung ikukumpara sa mga gumagamit ng *metal halide* at *halogen* na ilaw, maliban sa matipid itong gamitin. Mayroon ding ulat na nagsasabing ang paggamit ng *LED* na kumukurap ay nauuwi sa mas mabisang pagkahuli ng iba pang klase ng isda. Inaasahang sa hinaharap ay mapapaunlad pa ang teknolohiya sa paggamit ng *LED* na ilaw sa ibabaw man o sa ilalim ng tubig o kumbinasyon ng dalawa upang makahuli ng ninanais na uri ng isda.

3. Patunguhan ng pagsasaliksik sa hinaharap

Sa pangingisdang gamit ang *LED*, may apat na usaping dapat pagtuunan ng pansin. (1) Pagsasagawa ng pag-aaral sa paggamit ng *LED* sa buong panahon ng pangingisda, (2) Pagkuha ng sapat na impormasyon upang maunawaan ang balangkas ng paggamit ng enerhiya sa mga pangisdang bangka, (3) Liwanagin ang kaugnayan ng *wavelength*, lakas, at tagal ng pagkurap ng ilaw sa pag-uugali at galaw ng mga laman-dagat upang makagawa ng teknolohiya sa ibat-ibang paraan ng pangingisdang gamit ang ilaw, (4) Batay sa mga nabanggit, kailangan pa ang patuloy na paglinang sa paggamit ng *LED* bilang ilaw-pangisda.

VI. Pagtaya sa *greenhouse gas* sa industriya ng pangisdaan

Upang makagawa ng balangkas bunsod ng *Post Kyoto Protocol*, ang kabawasan ng usok na nagdudulot ng *greenhouse gas* ay ipinanukala sa maraming sektor. Upang maipatupad ang panukala sa industriya ng pangisdaan, kailangan ang pagsasagawa ng regular na pagtasa sa mga batayang panukat at magkaroon ng pangunahing kaalaman. Sa industriya ng pangisdaan, may mga batayan sa pagtaya ng *carbon dioxide emissions* mula sa konsumo ng mga bangkang pangisda. Subalit ang kabuuang *carbon dioxide emissions* sa buong industriya, na kinabibilangan ng pagpoproseso, paghuli, pag-aalaga (*aquaculture*), at pamamahagi, ay hindi pa ganap na nauunawaan. Upang mabawasan ang *greenhouse gas* mula sa industriya sa hinaharap, kailangan ang masusing pag-aaral at pagtaya gamit ang mga impormasyong nakalap sa mga nagdaang pagsasaliksik. Marapat na pag-aralan ang mga isinagawang pamamaraan sa pagbawas ng usok sa pamamaraang *quantitative* at maipakita ito upang magamit sa industriya ng pangisdaan. Subalit sa kasalukuyan, walang nakakaalam kung gaano karami ang usok na nagmumula sa ibat-ibang mga gawain na saklaw ng industriya. Sa pagsukat ng kabuuang usok, ang pag-unawa sa usok na mula sa bawat gawain mula sa pagkahuli hanggang sa pagkain ay mabigat na usapin. Sa hinaharap, ang *carbon footprint* na nagpapakita ng sukat ng enerhiyang ginagamit sa paghuli hanggang sa pamamahagi ng isda, na isinalin sa *carbon* ay imumungkahi. Makabubuting piliin ng mga mamimili ang produktong may mas mababang *carbon emission*. Samantala, products, each process from production to consumption is separated and it is impossible to provide consumers with information of carbon emission with the effort of only one company. Understanding the condition of emission in each process of fishery products such as fish catch, distribution and processing, estimating the emission amount and announcing the result officially will be basic data in order to conduct measurements towards the reduction of greenhouse gas emission in fishing industry.

Estimate of greenhouse gas emission is conducted by "Research of measurements towards global warming in the field of Agriculture, Forestry and Fisheries (National Research Project) " by commission project of deputy vice-minister of the ministry of Agriculture, Forestry and Fisheries in 2008. We would like to describe general appearance of it below.

Research of measures against global warming in the field of Agriculture, Forestry and Fisheries collected the data such as fuel consumption of fishing industry and aquaculture industry, analyzed and considered method for calculating greenhouse gas emission concerning fishery production, storage, distribution and processing and currently estimating the amount of emission. When estimating, the target is narrowed down to carbon dioxide among greenhouse gas, it is categorized by field of industry as shown in Image 1 and the amount of carbon dioxide is estimated. The fields which were estimated at present are capture fishery and aquaculture industry (Eel farming industry, laver farming industry and bait farming industry) at the stage of fish catch. At the stage of production area, the amount of emission from fridge-freezer, ice making industry and processing industry is estimated. Furthermore, estimate of CO2 emission during distribution process of fishery products is divided into 3 as below and estimated based on "Improved ton kilo method" of "Guideline on the method for calculating concerning CO2 emission in the distribution field" drew up by Ministry of Economy, Trade and Industry and Ministry of Land, Infrastructure, Transport and Tourism. (1) Distribution near production area (from fishing port to the prefecture where the fishing port is located) (2) Wide-area distribution (Inter-prefectural distribution: Production process of distribution of production area to outside the prefecture of production) (3) Distribution within the consumption area (Fishery products distribution process within the consumption area). It is important to continue the estimate and improve estimating the amount of other greenhouse gas not only carbon dioxide and also the fields which are not estimated yet.

Research agenda for the future should also include generation status other greenhouse gases not only carbon dioxide. There is also a need to see things from the viewpoint of life cycle assessment and estimate the amount of generation in fields which are not conducted yet (for example: 1.Fish box industry, 2.Tray industry 3.fishnet, disposal process of FRP fishing vessels, 4. Disposal process of residuum emitted from fish processing industry, 5. Disposal process of residuum emitted from the industry of last stages of distribution such as mass retailers) in fish processing related field and gather as basic data for greenhouse gas reduction measures in fish processing field.

VII. Proposal-Future efforts toward energy saving in the fishing industry

Fishing industry is a marine industry which is targeted at biological resources which can renew autonomously, thus it is originally possible to develop and maintain sustainably. From the view of energy consumption , constructing a sa larangan ng pangunahing bilihin na kinabibilangan ng mga yaman-tubig, ang mga gawain mula pagkahuli hanggang sa pamamahagi ay hiwa-hiwalay kung kaya't lubhang mahirap alamin ang sukat ng *carbon emission* sa pagsisikap lamang ng isang kumpanya. Marapat na maunawaan ang sukat ng *emission* sa bawat prosesong dinadaanan ng produktong isda gaya ng paghuli, pagproseso at pamamahagi, upang mataya ang dami ng *emission* at maipaalam at maisakatuparan ang pagbawas sa *greenhouse gas emission* sa industriya ng pangisdaan.

Ang pagtaya sa *greenhouse gas emission* na pinamagatang *Research of measurements towards global warming in the field of Agriculture, Forestry and Fisheries (National Research Project)* ay isinagawa ng *commission project* ng *Deputy Vice-Minister of The Ministry of Agriculture, Forestry and Fisheries* noong 2008. Ang mga sumusunod ay pagsasalarawan dito.

Sa mga pagsasaliksik tungkol sa pandaigdigang pag-init (*global warming*) sa larangan ng agrikultura, kagubatan at pangisdaan, nakalap ang mga datos, gaya ng konsumo ng langis-panggatong, sa mga larangang nabanggit at nagkaroon ng pamamaraan upang kalkulahin ang *greenhouse gas emission* sa bawat bahagi ng proseso upang malaman ang kabuuang dami ng *emission* sa bawat industriya. Sa pagtaya, ang pagtingin ay nakaumang sa *carbon dioxide* na nakabukod sa iba pang *greenhouse gas*ses, ito ay pinangkat ayon sa uri ng industriya na makikita sa *Image 1* kalakip ng dami ng tinatayang *carbon dioxide*. Ang mga larangang kasalukuyang tinataya ay kinabibilangan ng pangingisda (*capture*) at pag-aalaga ng isda (*aquaculture*) (*Eel farming industry, laver farming industry* at *bait farming industry*) sa bahagi ng pagkahuli ng isda. Sa bahagi ng produksiyon, ang dami ng *emission* sa palamigan, gawaan ng yelo at pagpoproseso ay nagkaroon na ng pagtaya. Dagdag pa rito, ang pagtaya sa CO_2 *emission* sa proseso ng pamamahagi ng produkto ay nahahati sa tatlo at tinaya gamit ang *Improved Ton Kilo Method* ng *Guideline on the method for calculating concerning CO2 emission in the distribution field* na ginawa ng *Ministry of Economy, Trade and Industry and Ministry of Land, Infrastructure, Transport and Tourism*. (1) Pamamahagi malapit sa mga pinagkukunan (mula sa bagsakan ng isda papunta sa probinsiyang kinaroroonan ng bagsakan) (2) Malawakang pamamahagi (Kalakalan sa karatig-probinsiya: Mula sa pinagmulan tungo sa karatig-probinsiya) (3) Pamamahagi sa loob ng lugar kung saan ito kinukonsumo (Pamamahagi ng mga produktong isda at yaman-dagat sa mga lugar kung saan ito kinukonsumo). Mahalagang paunlarin ang pamamaraan sa pagtaya ng dami ng *greenhouse gas* hindi lamang ng *carbon dioxide* kundi pati na rin sa iba pang bahagi na hindi pa natataya.

Ang mga talakayin sa pagsasaliksik sa hinaharap ay dapat sumaklaw sa epekto ng iba pang *greenhouse gas*es maliban sa *carbon dioxide*. Mainam rin na maunawaan ito sa punto ng *life cycle assessment* at alamin ang dami ng usok sa iba pang bahagi (halimbawa: 1. *Fish box industry*, 2. *Tray industry* 3. pagawaan ng lambat, paraan ng pagtatapon ng basura ng mga FRP, 4. Pagtatapon ng mga basura mula sa industriya ng mga nagpoproseso, 5. Pagtatapon ng basura sa duluhan ng industriya gaya ng pamilihan) at makagawa ng mga pamamaraan upang mabawasan ang *greenhouse gas emission*.

VII. Mungkahi – Gawain sa hinaharap tungo sa pagtitipid ng enerhiya sa industriya ng pangisdaan

Ang industriya ng pangisdaan ay industriyang karaniwang nakasalalay sa karagatan, kung saan ang pangunahing huli ay dumedepende sa buhay na yaman na kusang dumadami system to stably provide safety and safe food for people in the future, it is a key issue to switch to energy saving type which does not rely too much on fossil fuel such as petroleum oil, and enhancing competitiveness of our country's fishing industry.

In order to do so, while we try to positively come up with applicable energy saving technology for the time being and also reduce the fuel consumption, it is necessary to understand the actual condition of energy consumption (CO2 emission) in fishing industry. Based on the acknowledgment, we should try to promote research and development from medium term to long term viewpoint and solve current issues. Most important is to come up with the result to fishing regions as well as successively introduce the result to the field sites of fishing industry. More specifically, by cooperating with the government, public administration of each prefecture, research institutes, concerned organizations and concerned companies, we need to work on the issues keeping the ADCP cycle which is Plan (Understand the actual condition of energy consumption, bring it to into view), Do (Introduction and extension of existing countermeasure technology) , Check (Evaluation of technological introduction effects), Action (Improvement of existing countermeasure technology, development of new technology, extension and introduction)

1. Efforts toward the prevalence and practical realization of energy saving technology

(1) Holding of on-site meeting

In spite of existing applicable technology both in software field and hardware field, they are not being utilized fully in the field sites of fisheries. Therefore, for the time being we should cooperate with Fisheries Agency, prefectural governments, concerned organizations and FRA and hold on-site meetings timely towards fishing industry concerned parties to explain regarding the expected effects of existing energy saving technologies and suitability depending on the type of fisheries, using the brochure which is made and organized through this research group.

(2) Establishment of technical support system

For medium to long term, it is necessary to establish engineering system (a structure which works as a bridge between RD sites and fishing sites) to understand each need in fishing sites, analyze technical issues and connect to appropriate test research organization when needed. To be specific, based on the implementation status of on-site meetings described above, in order to prevail, it is vital to consider and establish a framework including developing budget plan, arranging role-sharing between Fisheries Agency, FRA, prefectural governments and concerned organizations, making documents such as improving brochures and developing human resources who will work directly in fishing sites.

2. Directions of future research development

(1) Immediate agendas

As fishing industry is suffering financially, it is difficult to make new investments. Therefore, FRA should play a central role while cooperating with prefectural governments and concerned organizations and focus on research and development which is described as below including applicable technical development towards existing fishing kung kaya't ito ay maaaring mapaunlad at mapangalagaan ng hindi lubusang nauubos. Sa ngalan ng pagtitipid ng enerhiya, ang susi ay ang pagkakaroon ng panghabang-panahong mapagkukunan ng ligtas na makakain sa pamamagitan ng ligtas na pamamaraan.

Upang maganap ito, habang ang lahat ay nagsisikap upang magkaroon ng angkop na teknolohiya sa pagtitipid ng konsumo at enerhiya, mahalagang maunawaan ang kasalukuyang kalagayan ng paggamit ng enerhiya (*CO_2 emission*) sa industriya ng pangisdaan. Dahil dito, kinakailangang palaganapin ang pagsasaliksik at pagpapaunlad sa katamtaman at pangmatagalang pagtanaw upang malutas ang kasalukuyang usapin. Mainam na makakuha ng resulta sa mga nangingisdang rehiyon at kaalinsunod na mapalaganap ito sa mga lugar na may industriya ng pangisdaan. Maisasakatuparan ito sa pamamagitan ng pakikipagtulungan sa mga lokal pamahalaan, mga kawanihan ng pananaliksik, mga kaakibat na mga samahan at mga kumpanya, gamit ang *ADCP cycle* kung saan: Magplano (Unawain ang kasalukuyang antas ng paggamit ng enerhiya), Gawin (Pagpapalaganap ng kasalukuyang teknolohiya ng pagtitipid), Suriin (Pagtasa sa mga epekto ng pinalaganap na teknolohiya), Gumalaw (Pagpapahusay sa kasalukuyang teknolohiya, pagpapunlad ng bagong teknolohiya at patuloy na pagpapalaganap).

1. Pagsisikap tungo sa pagtanggap sa mga teknolohiya ng pagtitipid ng enerhiya

(1) Pagsasagawa ng mga pagpupulong

Sa kabila ng mga naangkop na teknolohiya, kapwa sa larangan ng *software* at *hardware*, hindi pa ito lubusang nagagamit sa pangisdaan. Sa makatuwid, dapat makipagtulungan sa Kawanihan ng Pangisdaan, mga lokal na pamahalaan, mga may kinalamang samahan at *FRA* upang magsagawa ng mga napapanahong pagpupulong upang ipaliwanag ang mga inaasahang epekto ng kasalukuyang teknolohiya sa pagtitipid ng enerhiya na tumpak sa bawat uri ng pangisdaan, at gamitin ang mga polyetong ginawa ng grupo ng mga mananaliksik.

(2) Pagtatatag ng teknikal na pang-alalay

Sa hinaharap, kakailanganin ang pagtatatag ng *engineering system* (isang sistemang magiging tulay sa lugar ng pagsasaliksik at lugar ng pangisdaan) upang maunawaan ang bawat pangangailangan ng mga pangisdaan, suriin ang mga usaping teknikal at makipag-ugnayan sa mga angkop na samahan ng mga mananaliksik kung kinakailangan. Sa makatuwid, mula sa bunga ng mga pagpupulong, mahalagang isaalang-alang ang pagbuo ng balangkas, kabilang na ang planong pinansiyal, pag-aayos ng bahaginan ng papel sa pagitan ng Kawanihan ng Pangisdaan, *FRA* mga lokal na pamahalaan at mga samahan, paggawa ng mga dokumento, at paglilinang ng mga yaman-tao na makikipagtulungan sa mga lugar ng pangisdaan .

2. Tunguhin ng pagsasaliksik at pagpapaunlad sa hinaharap

(1) Agarang Usapin

Mahirap mamuhunan ng bago sapagkat naghihikahos ang industriya ng pangisdaan. Dahil dito, ang *FRA* ay dapat pumagitna habang nakikipag-ugnayan sa mga lokal na pamahalaan vessels.

1) Understanding the actual condition of energy consumption in fishing industry

Under existing conditions of capture fishery, there are only cases of fuel consumption of private fishing vessels chartered by FRA. We will try to understand the actual conditions of implementation cases of pilot projects and incentive projects by Fisheries Agency. Also, regarding actual condition of CO_2 emission and energy consumption in the process of transport, distribution and storage of fishery products including aquaculture industry, fishery product processing and imported fishery products, we should establish the calculation methods using the examples from the cases of other fields of industry and estimate the amount and organize it as a basic document of energy saving measures in fishing industry and CO_2 emission measures.

2) Improvement and stabilization of existing technology and development of the measures to determine the cost-effectiveness of technological introduction

While improved technology of formation of hull and bow and the improved technology of engine parts require certain cost, currently the effects of it vary significantly depending on the type of fishing and vessels. Therefore, as well as collecting data which include cases of technological introduction and verification test in pilot projects and incentive projects by Fisheries Agency, we should make efforts to improve and stabilize retrofit technology through water tank test and numerical experiment using model vessel. Furthermore, based on the comparison between experiments and the data of actual vessel remodeling we should develop methods to estimate the effects of remodeling and draw up guidelines of cost-effectiveness of technological introduction. The measures which are applicable to small size coastal fishing vessels are limited to the ones in the field of software such as reduction of speed and weight. Through implementation result of a various kinds of verification experiments and technological introduction projects, model experiment and numerical experiment, specific guidelines in applying measures of software by type of fishing should be considered and determined. In addition, balanced fishing vessel which corresponds to sea area, usage and type of fishery and also considered safety and working environment including hull size, vessel type, equipment (fishing equipment), formation of engine and power, should be suggested.

3) Establishment of the technology utilizing LED fishing lamps

Certain effects of using LED fishing lamps are seen in squid fishing, saury square net fishing and purse seine fishing; however it is necessary to clarify effective usage and position by understanding reaction characteristic towards LED fishing lamps of targeted creatures in order to get same amount of fish as when conventional fishing lamps are used. Behavioral physiological effects of swarming of LED lamps towards targeted fish as well as promoting verification experiments cooperating with prefectural governments and concerned organizations should be done at the same time. By reflecting the result for verification experiments as needed, proper usage using both LED fishing lamps and existing fishing lamps and effective usage of LED fishing lamps depending on the season, at mga samahan, at magsagawa ng mga saliksik upang malinang pa ang mga pamamaraan na ginagamit sa mga bangkang pangisda, gaya sa mga babanggitin sa ibaba.

1) Pag-unawa sa kasalukuyang kalagayan ng paggamit ng enerhiya sa industriya ng pangisdaan

Sa kasalukuyang lagay ng pangisdaan, ang mga pag-aaral na ginawa ng *FRA* tungkol sa paggamit ng langis-panggatong ay nakatuon lamang sa mga pribadong kumpanya. Susubukan nating unawain ang kasalukuyang lagay ng pagpapatupad ng mga pangunahing proyekto at insentibo ng Kawanihan ng Pangisdaan. Mainam rin na magkaroon ng tamang paraan ng pagtaya sa kasalukuyang kalagayan ng CO_2 *emission* sa paggamit ng enerhiya sa pangisdaan, lalung-lalo na sa mga bahagi ng paghuli, pag-iimbak, pagpoproseso, pagbibiyahe, at pamamahagi, kabilang na ang pag-aalaga ng isda at industriya ng pag-aangkat upang magkaroon ng sapat na basehan batay sa karanasan ng iba pang industriya.

2) Pagpapahusay sa mga teknolohiya at pagpapa-unlad sa kaalaman tungkol sa katipirang bunga ng pagpapalaganap dito

Habang ang pagpapahusay sa teknolohiyang may kinalaman sa hugis ng katawan at nguso ng bangka at mga bahagi ng makina ay nangangahulugan ng gastusin, ang epektong dulot naman nito ay magkakaiba batay sa uri ng bangkang pangisda. Sa makatuwid, bukod sa pagkuha ng mga impormasyon sa mga kaso ng pagpapalaganap ng teknolohiya at mga patunay sa mga proyekto ng Kawanihan ng Pangisdaan, dapat ding paghusayin ang mga kasalukuyang teknolohiya sa pamamagitan ng pagsubok sa tubig at teknikong eksperimento gamit ang modelo ng mga bangkang pangisda. Dagdag pa rito, kailangang magkaroon ng pamamaraan upang mataya ang epekto ayon sa pagbabago ng modelo upang makagawa ng mga alituntunin sa pinakaepektibo ngunit murang pagpapalaganap ng teknolohiya. Ang mga pamamaraang angkop sa mga maliliit na bangkang pangisda ay limitado sa tinatawag na *field software* kagaya ng pagpapabagal sa takbo at pagpapagaan ng bangka. Sa pamamagitan ng pagsasagawa ng mga proyektong batay sa mga nagawang pagsasaliksik sa pagtitipid ng enerhiya, ang mga tukoy na alituntunin upang maisakatuparan ang mga pamamaraang *software* na ukol sa uri ng bangkang pangisda ay dapat alamin at pahalagahan. Maari ring imungkahi ang wastong disenyo ng bangkang pangisda ayon sa lugar na pangingisdaan, gamit at uri ng pangisdaan, at bigyang-pansin ang kaligtasan at maayos na gawaan, pati na rin ang laki ng katawan ng bangka, uri ng bangka, uri ng gamit-pangisda, at lakas ng makina.

3) Pagkakaron ng teknolohiya gamit ang *LED* na ilaw pangisda

Ilang epekto ng paggamit ng *LED* na ilaw-pangisda ang nakita sa paghuli ng pusit, paggamit ng *saury square net* at pangulong; ngunit kailangang liwanagin ang mas epektibong pamamaraan ng paggamit, batay sa reaksiyon sa *LED* na ilaw-pangisda ng mga isdang huhulihin, upang siguruhing mas marami ang huli sa pamamagitan nito. Marapat na sabay isagawa ang mga pagsasaliksik sa epekto ng *LED* na ilaw-pangisda sa mga asal ng isda at ang pakikipag-ugnayan sa mga lokal na pamahalaan at mga kaakibat na samahan. Sa pamamagitan ng pagpapakita ng bunga ng mga pagsasaliksik, ang wastong paggamit ng *LED* na ilaw-pangisda, kumpara sa mga sinaunang uri ng ilaw, ay maaring palaganapin at maaring imungkahi ayon sa panahon, lugar na paggagamitan, at uri ng pangingisda.

sea area and type of fishing will be suggested.

Also, we have background of controlling method of using lights to collect fish from the point of controlling fishing resource. We need to consider from the point of controlling fishing resource so that utilization of LED fishing lamps shall not excess the proper fish catch level.

4) Scientific verification of proper temperature for cold storage

There is huge energy saving effect by rising temperature for cold storage of skipjack and tuna which are stored frozen in extreme low-temperature (-50 degrees) now, however it is not yet clear how the rise in storage temperature will influence the quality in long-term. Also, we need to pay attention to the reaction of consumers and business practice in distribution process. Thus, we will clarify the relation between temperature for cold storage and quality change in long term for tuna and skipjack in order to make clear temperature for cold storage from both side, energy saving and value of products. Also, we need to understand the condition of temperature change of products and the condition of temperature control in distribution process from survey, evaluate the influence to quality and suggest balanced set value of temperature for cold storage from the viewpoints of energy saving measures, value of products and current distribution system.

Furthermore, we need to do research on the condition of temperature for cold storage for other fishery products than tuna and skipjack in order to collect basic document to consider low-carbonized and future energy saving in distribution for the whole fishery products.

(2) Medium and long term issues

In order to enhance industrial competitiveness of our country's fishing industry by switching fishing industry to energy-saving and changing to low-carbon industrial structure and also to recover as foundational industry in coastal and isolated islands regions by expanding the range of fishing industry which result in creating new employment, for medium to long period of time, FRA should play a central role under cooperation of chamber of commerce , industry, agriculture and fishery using existing and currently developing technologies as a base and need to work on the research development as described below.

1) Development and use of renewable energy

(1) Development of complex utilization technology of natural energy

Regarding fishing villages and isolated islands regions, we need to consider basic facility for fishing industry such as fishing ports, processing and storage facilities, introduction of wind, solar, sea, tide current power generation as a power supply for back settlements and effective supply and utilization system which includes complex utilization of those.

(2) Development of cyclic use of technology using biomass resources in regions

It is necessary to develop cyclic use technology of local production for local consumption of biomass resources such

Batid rin natin na mayroon na tayong karanasan sa paghihigpit sa paggamit ng ilaw sa pangingisda upang mapangalagaan ang yaman-tubig. Kailangang gamitin ang kaalaman sa pangangalaga ng yaman-tubig upang siguruhin na ang paggamit ng *LED* na ilaw-pangisda ay hindi mauuwi sa pagkahuli ng isdang lampas sa itinakdang dami.

4) Maka-agham na pamamaraan sa pagsusuri ng tamang temperatura sa palamigan

May malaking epekto sa pagtitipid ng enerhiya kung itataas ang temperatura sa palamigan ng tambakol at tuna na karaniwang iniimbak sa napakababang temperatura (-50 *degrees*) sa ngayon, ngunit hindi pa maliwanag kung paano maaapektuhan ng pagtaas ng temperatura and kalidad sa katagalan. Dagdag pa, kailangang bigyang pansin ang reaksiyon ng mga mamimili at mangangalakal sa paraan ng pamamahagi. Sa makatuwid, kailangan pang pag-aralan ang ugnayan ng temperatura sa palamigan at pagbabago ng kalidad habang tumatagal, para sa tambakol at tuna, upang makuha ang nararapat na lamig sa punto ng pagtitipid ng enerhiya at kahalagahan ng produkto. Kailangan ding maunawaan ang pagbabago ng temperatura ng produkto at pamamahala sa temperatura sa panahon ng pamamahagi base sa mga pagsisiyasat, suriin ang epekto nito sa kalidad at magmungkahi ng wastong temperatura sa palamigan sa punto ng pagtitipid ng enerhiya, kahalagahan ng produkto at kasalukuyang pamamaraan ng pamamahagi.

Dagdag pa rito, kailangang magsagawa ng mga pagsasaliksik sa temperatura ng palamigan para sa iba pang produktong isda maliban sa tambakol at tuna upang makakalap ng magagamit na batayan sa hinaharap sa paggawa ng *low-carbon* at matipid sa enerhiyang pamamaraan sa pamamahagi ng produkto ng pangisdaan.

(2) Mga usapin sa hinaharap

Upang maragdagan ang kalakasan ng pambansang industriya ng pangisdaan, ang *FRA* ay dapat manguna sa pakikipagtulungan sa bulwagan ng komersiyo, industriya ng sakahan at pangisdaan, gamit ang kasalukuyang mga teknolohiya bilang batayan, upang makalipat sa mas matipid sa enerhiyang mga pamamaraan at makagawa ng balangkas ng industriyang *low-carbon*, mapalawak ang sakop na uri ng industriya ng pangisdaan at makagawa ng karagdagang mapagkakakitaan.

1) Paglinang at paggamit ng napanunumbalik na enerhiya

(1) Paglinang sa teknolohiya ng natural na enerhiya

Kinakailangan pa ang paglinang sa mga teknolohiya ng natural na enerhiya gaya ng paggamit ng lakas-hangin, dagat, kuryente mula sa alon upang matugunan ang mga pangangailangan sa enerhiya ng mga pamayanan ng mga mangingisda at mga malalayong isla na nangangailangan ng pangunahing mga pasilidad gaya ng bagsakan, pagawaan at imbakan ng isda.

(2) Paglinang ng paikot na paggamit sa mga teknolohiyang ginagamitan ng *biomass*

Kinakailangan ang pagkakaroon at pagpapaunlad ng paikot na paggamit ng mga as production of biodiesel fuel (BDF) utilizing biomass of fishery products wastes, marine alga and seaweed.

(3) Development of regenerable energy supply technology for production in fishing and aquaculture industry

It is necessary to arrange system and technology between producers and suppliers in order to make it possible to use BDF and other resources mentioned above for production of fishing and aquaculture industry in regions.

2) Establishment of low carbon emission fishing industry and aquaculture industry production system

(1) Establishment of production system for fishing industry which is described as "Safe, Close, Short"

We need to construct database and monitoring system of ocean information and fish school location information in natural fisheries and artificial fisheries (medium rise and bottom rise fish reef area) near our country and also improve information transmission technology and fishing site formation estimate due to numerical model. Also, regarding the construction of artificial fishing sites and maintenance of fishing sites environment, they should actively be promoted in sea area where swarming of fish school and cultured resources effects are expected. By doing so, we can form fixed fishing sites in coast and offshore in our country, which will stabilize the production and reduce operating cost including search for capture fisheries. In addition, the effect may be expected in ensuring the safety of maritime labor.

(2) Development of fisheries forecasting model with high accuracy

Energy saving and cost saving are implemented by changing from a group of vessel operation to single vessel operation. In general, single vessel operation is hampered by low ability to search targeted fish compared to operation by a group of vessel. How to find targeted fish school more effectively is important issue in energy saving. These days, accuracy of numerical model to express ecosystem including fish which lives close to the surface is extremely high. Also, accuracy of oceanic condition forecasting model utilizing satellite information is improving and it used to forecast the appearance of large size jelly fish. As well as establishing fishery production system which is described as "Safe, Close, Short", we should actively promote the development of fisheries forecasting model with high accuracy to reduce searching cost and make efforts to save energy by production system based on scheduled production. Moreover, technological development of real time monitoring system of targeted fish school by unmanned airborne vehicle to verify the forecast of fisheries forecasting model is an agenda to be examined in the future.

(3) Development of energy-saving and cost-saving fishing vessels (Super-eco fishing vessels)

With the purpose of preparing to alternate existing fishing vessels which will be needed in the future, it is necessary to utilize regenerable natural resources mentioned above (electric and hybrid propulsion), implement drastic energy saving and cost saving in hull form, engines and equipment and develop technology to operate/construct super-eco fishing vessel which is equipped with abilities to analyze and utilize various fisheries teknolohiyang nakasalalay sa *biomass* sa mga lugar kung saan makakuha ng sangkap at magagamit ang produktong gaya ng *Biodiesel fuel* (*BDF*) mula sa mga patapong bahagi ng isda, mga damong-dagat at iba pang halaman-dagat .

(3) Pagkakaroon ng teknolohiya sa napanunumbalik na enerhiya para sa pangingisda at pag-aalaga ng isda (*aquaculture*)

Kinakailangang maisaayos ang sistema at teknolohiya sa pagitan ng mga gumagawa at nakikinabang upang magamit ang *BDF* at iba pang yaman na nabanggit sa itaas para sa industriya ng pangingisda at pag-aalaga ng isda.

2) Pagtatatag ng industriya ng pangingisda na mababa ang *carbon emission* at industriya ng pag-aalaga ng isda

(1) Pagtatatag ng industriya ng pangisdaan na mailalarawan bilang Ligtas, Malapit, at Maigsi

Kailangang makagawa ng *database* at paraan ng pagsubaybay sa karagatan at mga impormasyon tungkol sa mga grupo ng isda sa natural at di-natural na pangisdaan (bahagya at matarik na lugar ng mga isdang-bahura) malapit sa bansa at mapabuti ang paghahatid ng mga teknolohiya at pagtaya sa kalagayan ng pangisdaan base sa mga modelong matematiko. Dagdag dito, ang paggawa at pangangasiwa sa mga di-natural na lugar na kahuhulihan ng isda ay dapat palaganapin lamang sa karagatang maaasahan ang pagdami ng inaalagaang isda. Sa pamamagitan nito, maaring magkaroon ng mga lugar kung saan sigurado ang huling isda upang mapanatili ang laki ng produksiyon habang napapababa ang gastusin sa pangingisda. Dagdag din sa magiging epekto ang kaligtasan ng mga manggagawang-dagat.

(2) Pagkakaroon ng pampangisdaang modelo sa tumpak na pagtaya

Ang patitipid sa enerhiya at gastusin ay maisasakatuparan kapag gumamit ng iisang bangka kumpara sa maraming bangka sa paghahanap ng isda. Karaniwan, hirap makakita ng isda kung isang bangka lamang ang gagamitin sa paghahanap. Kung paano mapapahusay ang paghahanap sa grupo ng isdang mahuhuli ay isang mahalagang usapin sa pagtitipid ng enerhiya. Sa ngayon, mataas ang kakayahan ng mga matematikong modelo sa pagtukoy sa mga ekosistema, kabilang na ang mga isdang nabubuhay malapit sa ibabaw ng tubig. Maging ang pagtukoy ng matematikong modelo para sa ilalim ng dagat, gamit ang impormasyon galing sa *satellite*, ay humuhusay na rin kaya, halimbawa, ang mga malalaking dikya ay natuklasan na. Gaya ng pagtatatag ng industriya ng pangisdaan na mailalarawan bilang Ligtas, Malapit, at Maigsi, kailangan din nating puspusang palaganapin ang paglinang sa mga matematikong modelo ng pagtaya upang mabawasan ang gastusin sa paghahanap ng mahuhuli at makapagtipid ng enerhiya. Bukod dito, ang pagpapaunlad sa teknolohiya ng pagsubaybay sa huhulihing isda gamit ang sasakyang panghimpapawid na walang tao, upang mapatunayan ang galing ng matematikong modelo, ay dapat suriin sa hinaharap.

(3) Paggawa ng matipid sa enerhiya at matipid sa gastusing bangkang pangisda (*Super-eco fishing vessels*)

Bilang paghahanda para sa pagpapalit ng mga bangka sa hinaharap, mahalagang gumamit ng mga napanunumbalik na natural na yamang nabanggit (*electric and hybrid propulsion*), isakatuparan ang pagpapahusay sa katawan ng bangka, makina at kasangkapan, at makagawa ng teknolohiya ng *super-eco fishing vessel* na may kakayahang gumamit ng mga impormasyong-pampangisdaan na binanggit kanina. Kailangang isaalang-alang ang information mentioned above. We need to consider promoting energy saving by effective utilization of facility. To be more specific, we need to disperse risks by constructing a multiple versatile fishing vessel (multiple-purpose vessel) instead of vessel of which operation is only targeted at one specific kind of fish in order to convert to the production structure which is able to utilize the facilities all year round.

Energy saving by establishing transportation system on the ocean should also be taken into consideration. For example, in saury square net fishing, each vessel brings in the saury that they caught to markets. By establishing transportation system on the ocean, a large amount of energy can be conserved.

(4) Technological development for energy saving and cost saving in aquaculture industry

It requires the implementation of energy saving and cost saving by improvement in ability to keep the temperature of breeding water tank warm, introduction of automatic feeder and automatic taking up device in existing aquaculture production process. It is necessary to promote developing required technologies by considering development and direct utilization technology of regenerable energy which is mentioned above and also the forms and locations of aquaculture production which is preferred for the utilization. (For example: Moored/ Ocean floating method coastal aqua farming, onshore aqua farming etc.)

Furthermore, it is vital to produce new breeds which are excellent at growth and improve feeds in order to reduce feeds in aqua farming which requires feeding in parallel with creating measures to reduce (collect) environmental burdens by combination with resources biomass (marine alga, plants etc.) production.

3) Establishment of low-carbon fishing industry and aquaculture industry production system

Against a backdrop of scientific verification result regarding proper temperature for cold storage, it is necessary to examine technical problems for establishing low-carbon consuming distribution and storage system of frozen fishery products which is consistent from production, processing to consumption and resolve the problems. In such case, understandings of consumers and distribution industry are essential. To be more specific, we need to continue improving element technology and system and also examining the issues through alternating from transportation by cars and airplanes to transportation by rail and marine vessels (modal shift) and implementing milk run to collect from markets to rail and marine vessels. Moreover, it is necessary to pay attention to cooperation with distribution system of other industries.

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pagpapalaganap sa pagtitipid ng enerhiya sa pamamagitan ng mabisang paggamit ng mga pasilidad. Upang maging mas tiyak, kailangang ibsan ang panganib sa pamamagitan ng paggawa ng bangkang maraming mapaggagamitan (*multi-purpose vessel*), sa halip na nakatuon lamang sa iisang uri ng mahuhuling isda, upang magamit ito sa buong taon.

Dapat ding pagtuunan ng pansin ang pagkakaroon ng sistema ng transportasyon sa karagatan bilang isang paraan sa pagtitipid ng enerhiya. Halimbawa, sa pangingisda gamit ang *saury square net*, bawat bangka ay kailangang magdala ng kanilang huli sa pamilihan. Kung may paraan upang may ilan lamang na bangka ang magdadala ng mga huli sa pamilihan, makakatipid ng malaki sa enerhiyang kinakailangan.

(4) Pag-unlad ng teknolohiya sa pagtitipid ng enerhiya at gastusin sa industriya ng pag-aalaga ng isda

Nangangailangan ito ng pamamaraan sa pagtitipid ng enerhiya at gastusin sa pamamagitan ng pagpapahusay sa pagpapanatili ng init sa tangke, paggamit ng awtomatikong tagapakain, at awtomatikong panghuli sa inaalagaang isda. Nararapat na palaganapin ang pagpapaunlad sa mga kinakailangang teknolohiya sa pamamagitan ng paggamit ng napanunumbalik na enerhiya at malaman kung saang bahagi ng pag-aalaga ng isda ito aakma. (Halimbawa: Naka-angkla/nakalutang na pamamaraan, pag-aalaga ng isda sa malapit sa baybayin, pag-aalaga malayo sa baybayin, at iba pa)

Bukod dito, mahalaga ring magkaroon ng bagong uri ng isda na mabilis lumaki, mapabuti ang kalidad ng pakain upang mabawasan ang kailangang dami ng pakain, makagawa ng mga hakbang upang mabawasan (tipunin) ang pabigat sa kapaligiran sa pamamagitan ng sama-samang pag-aalaga ng iba pang yaman-dagat (damong-dagat, halamang-dagat, at iba pa).

3) Pagtatatag ng industriya ng pangingisda na mababa ang *carbon emission* at industriya ng pag-aalaga ng isda

Sa likod ng maka-agham na pagsusuri sa resultang may kinalaman sa tamang temperatura para sa palamigan, nararapat na patunayan at suriin ang mga teknikal na suliranin sa pagtatatag ng paraan ng pag-iimbak at pamamahagi ng isda na mababa ang *carbon emission* na magkasang-ayon mula sa pagkakahuli, pagpoproseso at pagdating sa pamilihan. Dahil dito, mahalagaang maunawaan ang uri ng mga mamimili at ang industriya ng pamamahagi. Kailangang ituloy ang paglinang sa teknolohiya at mga sistema, gayundin ang pagsusuri sa mga usaping masusumpungan sa hinaharap. Mahalaga ring pagtutunan ang pakikipagtulungan sa sistema ng pamamahagi na karaniwan nang ginagamit sa iba pang industriya.

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Estimate of energy saving effects and fuel consumption amount by major fishing types

As for each fishing vessel of which data of operational condition and fuel consumption condition were obtained, we estimated fuel consumption of main engine and auxiliary engine and estimated the effects, depending on each operational condition such as during sailing, operation and anchorage, by type of fishing, in order to estimate the effects in case energy saving measures are implemented for fishing vessels. The estimate of energy saving effects which is shown from following page is maximum value as a reference in case all the measures are implemented.

In case it is difficult to input numerical values, it is shown only in the color of cell. Green shows roughly 5%, light blue shows roughly less than 5%, red on the other hand shows increase of fuel consumption and white shows that it does not fall under any of these. Energy saving effects may vary significantly depending on statues of use, specification and size of fishing vessel. Also, as for fishing vessels which are already equipped with devices for energy saving such as bulbous bow, concerning corresponding article shown in yellow “if the equipment corresponds, it is effective”, please be noted that there is no energy saving effects.

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Taya sa epekto ng katipiran sa enerhiya at dami ng konsumo ayon sa pangunahing uri ng bangkang pangisda

Sa bawat bangkang pangisda, tinaya ang konsumo ng pangunahin at pantulong na makina upang makuha ang epekto batay sa kung ito ay naglalayag o nakaangkla, ayon sa uri ng gamit-pangisda, at kung ito ba ay gumamit ng pamamaraan upang makatipid sa enerhiya. Ang tayang epekto sa katipiran na ipinapakita sa susunod na pahina ay ang pinakamataas na bilang na batayan sakaling lahat ng pamamaraan ng pagtitipid ay naisakatuparan .

Kapag mahirap maglagay ng kaukulang bilang, ipinapakita lamang ito sa kulay ng selda. Berde kung halos 5%, asul kung mas mababa sa 5%, pula kung tumaas ang konsumo at puti kung di kabilang sa alinman. Ang katipiran sa enerhiya ay magkaiba ayon sa lagay ng paggamit, uri at laki ng bangkang pangisda. Gayundin, sa mga bangkang pangisda na nagtataglay na ng mga kasangkapang makatutulong sa pagtitipid ng enerhiya gaya ng bulbo sa nguso, sa artikulong dilaw na kapag may kagamitang angkop, ito ay mabisa, laging tandaan na walang naiulat na epekto ng katipiran sa enerhiya .

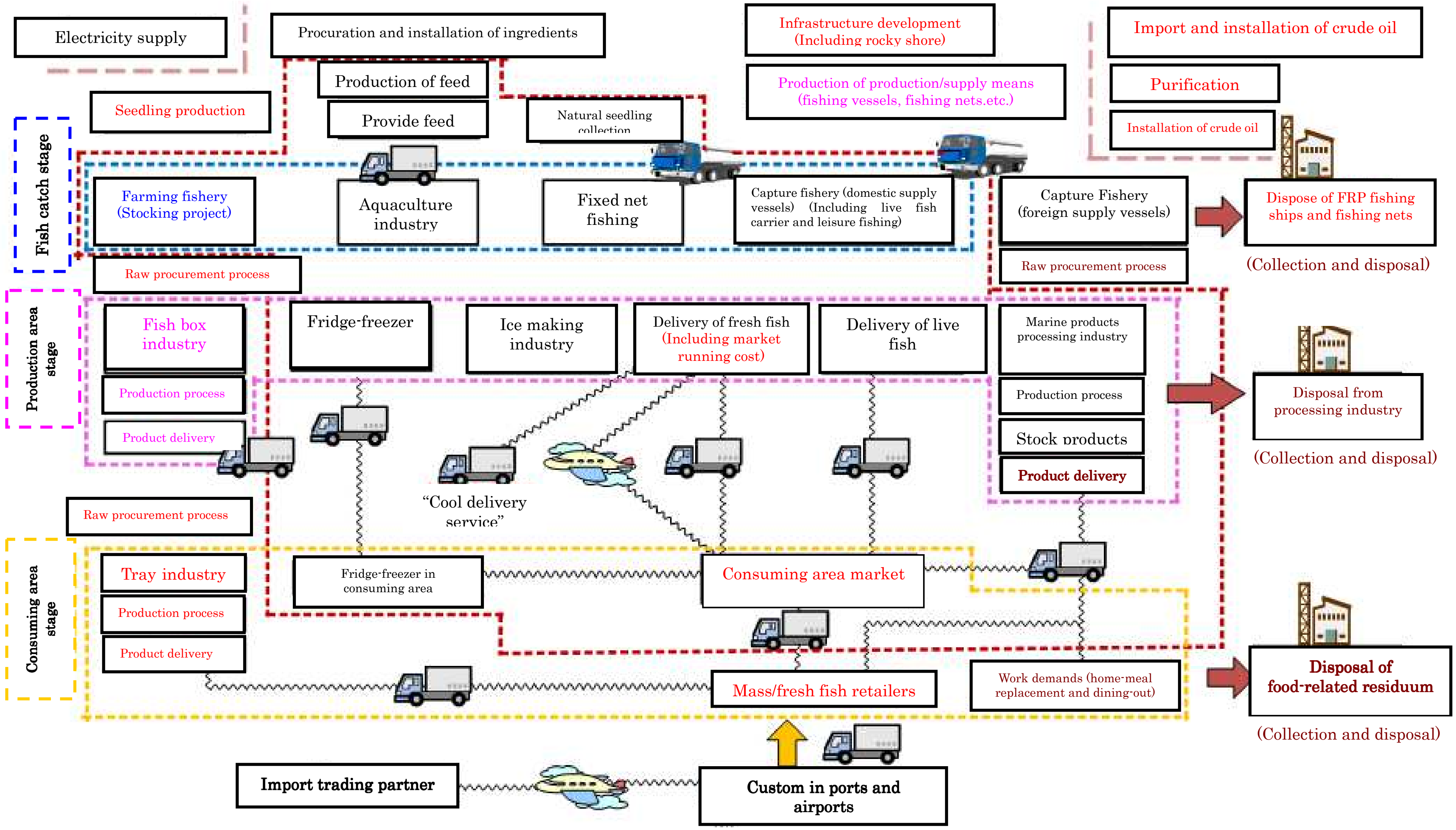
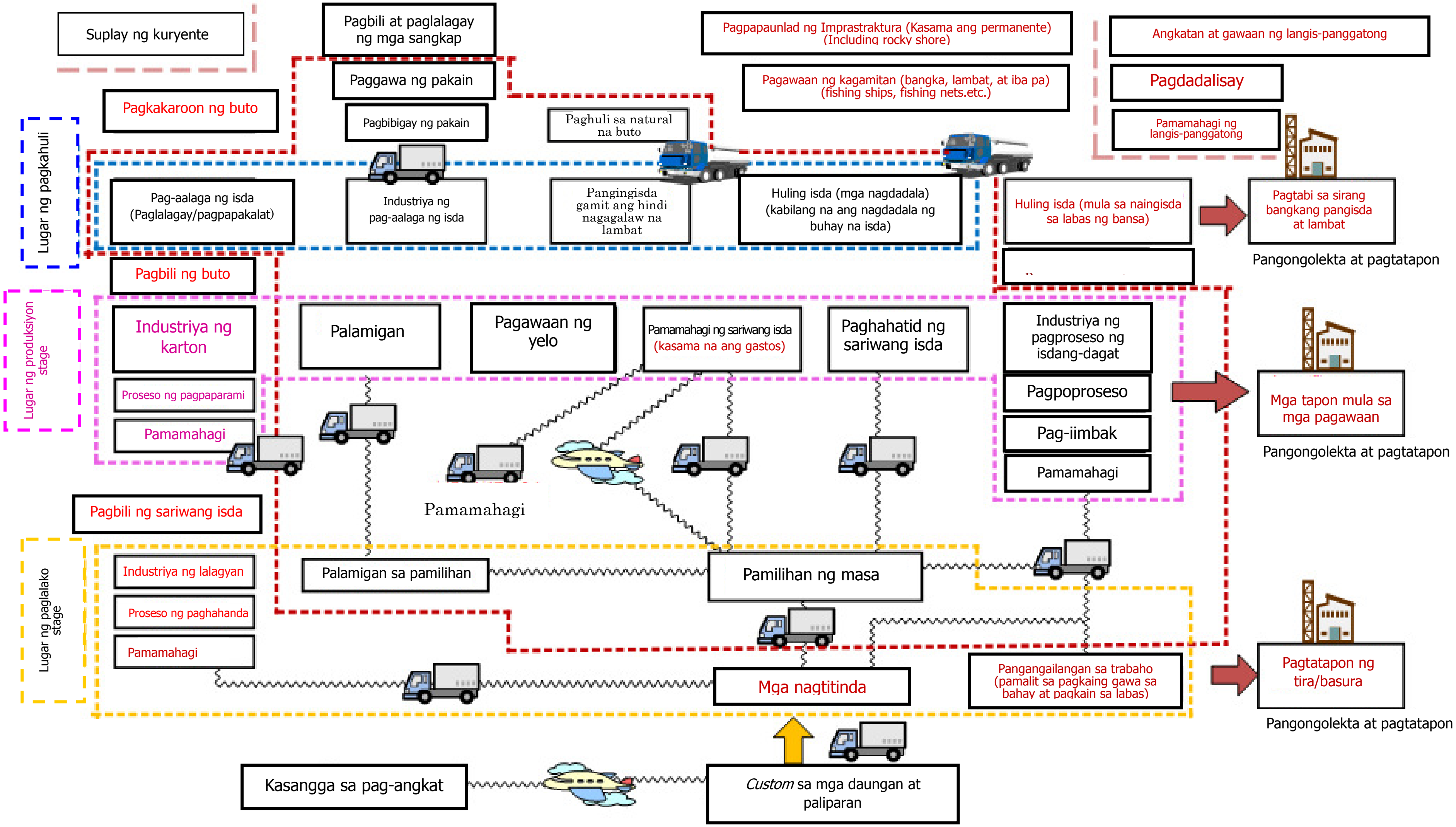


Image of coverage of global warming measurement research in the field of Agriculture, Forestry and Fisheries. (National research project)
Words in black: fields which are under estimate now Words in red: fields which should be estimated in the future



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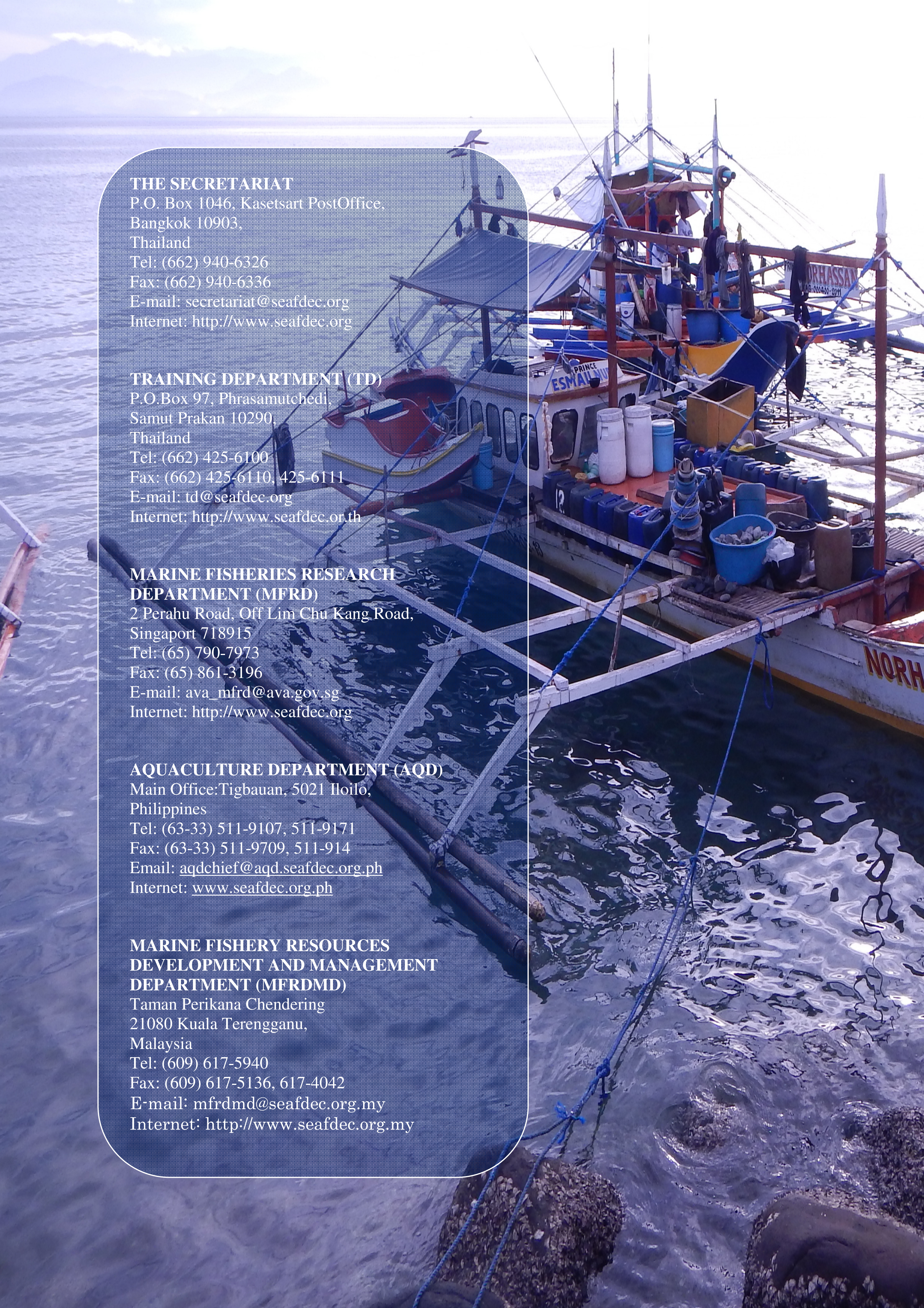

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