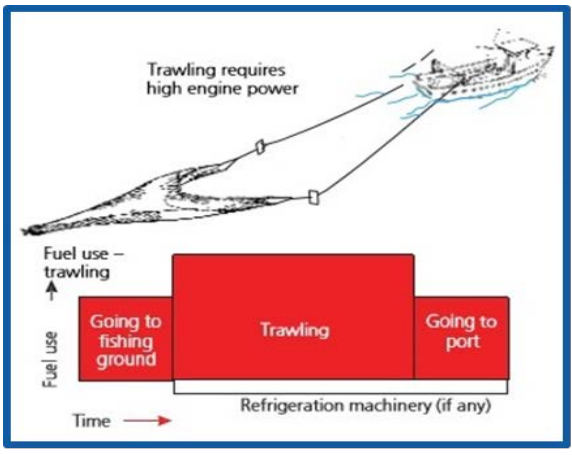
Practical Training on Energy Audits for Fishing Vessels

Food and Agriculture Organization of the United Nations

gef



REBYC-II CTI

SEAFDEC

Southeast Asian Fisheries Development Center (SEAFDEC)

Training Department

"Strategies for Trawl Fisheries Bycatch Management" Project

REBYC-II CTI

January 23-27, 2017

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I. Introduction

1. Fuel flow meters are used to serve as real-time display of engine fuel economy on fishing vessel during operations, but are also an effective means to monitor engine and vessel performance. Fitting fuel flow meters can have a positive impact on fuel consumption, particularly with respect to savings made whilst steaming. Even small adjustments to revolve settings can result in significant fuel savings of around 10 – 20%.

2. Promotion of energy audits in the fisheries sector is a tool for fishers to evaluate how much energy is used in overall fishing activities. This kind of action is a way to find out where excess energy is used in fishing activities. Improving fuel efficiency is an important factor because loss of energy often results in higher fishing operation cost, which can result in financial constraints for boat owners and fishers/crew income. Moreover, higher fuel consumption rate directly impacts fishery resources and environment, e.g. impact on sustainable food security from sea and oceans caused by the impact from green house gas emission from fishing vessels.

3. Fishing Vessel Energy Audit in Thai trawl vessels is a process applied in fishing vessels energy audits based on an Australian concept model. This aims to determine how much energy is used in each of the vessel's systems especially in propulsion system, considered as main sources of fossil fuel consumption and green house gas emission. Fishing fuel consumption is influenced by various factors i.e. steaming distance, vessel speed, towing period, water and wind resistance. Energy audits process comprises of several measuring equipment e.g. fuel flow meter, tachometer, GPS and data logger system (manually operated/automatic). An energy audit not only involves application of sensitive instrumentation but also needs skilled persons to be involved in the process. The process of data collection on the parameters for fishing vessel energy audits will identify the sources of high rate of fuel consumption and losses of energy on fishing vessel operation. The analysis then provides suggestions/discussion on energy efficiency.

4. The Southeast Asian Fisheries Development Center (SEAFDEC) and the Food and Agriculture Organization of the United Nations (FAO) have cooperated in a project from 2014 to 2016 to study the amount of fuel consumption and follow up with the greenhouse gas emission and revenue for each kilogram of catch in Thai trawl fishery. The project studies 6 representative trawl vessels, two in three size categories (i.e. small, middle and large size vessels). The overall objective of the study was to improve economic return and fuel efficiency, reduce dependency on fossil fuels, minimize waste and impacts of fishing operations to the environment through access to technical assistance, sharing and formulation of best practices. Injuries and vulnerability are reduced through provision of technical advice and best practices on operational safety associated with modification of vessel design, construction, and operation of vessels, related equipment and infrastructure, responding to energy efficiency and safety at sea.

II. Summary

5. A five days practical training course was organized at SEAFDEC/TD Samutprakan Province from 23 -27 January 2017, with full financial support by the FAO REBYC-II CTI Project. This was aimed at providing technology transfer on the process and method of fishing vessels energy audits to both fishery officers of REBYC-II CTI member countries (Indonesia, The Philippines, Thailand and Viet Nam) and non-REBYC member countries (Malaysia and Myanmar). The

training program consisted of 3 modules: presentations, practice demonstration at workshop and onboard fishing vessel, and discussion. The training program focused on capacity building of human resource in capture fishery on reducing the burning of fossil fuel used in capture fisheries by increasing the fuel efficiency (energy saving) including monitoring of the fuel consumption. The participants were given practical sessions on fuel consumption monitoring and data collection through practical test at sea and analysis on fishing vessel energy audits process.

6. The participants successfully consolidated learning in a progressive manner on fishing vessel energy audits process. This report presents the course outlines, methodology and details of the content of each training day. Results and recommendations from this practical training will be taken to improve the training program on fishing vessel energy audits in future. Details of the presentations from lecturers are as follows:

    - Sharing the information and recommendations for fishing vessels carbon emission and its reduction
    - Introduction to fishing vessels energy audits
    - Sharing the results of SEAFDEC and FAO fishing vessels energy audits for pilot project on Thai trawl vessels. Theory on basic engine maintenance, periodical checks and engine trouble shooting of marine engines
    - Demonstration and practice on basic engine maintenance, periodical check, trouble shooting, engine performance test for fuel consumption measure. Energy efficiency and energy saving for fishing operation
    - Increasing fuel efficiency through the implementation of gears design/materials/ construction/fishing operation
    - Practical training for installation of onboard equipment/tools for fishing vessels energy audits
    - Ship on board training
    - Results of fishing vessel fuel audits for fuel consumption and catch profile at sea trial tested.
    - Conclusion on fishing vessels fuel audits as well as recommendation and clarification for future work.

III. Background

7. Fishing, in particular the bottom trawl fishing, is one of the most energy-intensive food production methods. Fishing vessels carbon emissions are influenced by several factors including abundance of fish (stocks), the steaming distance to and back from fishing grounds, and the fishing technology used. Every ton of fuel used produces about 2.25 tons of CO_2. The use of fuel in trawl fisheries results in considerable costs and also significant emissions of greenhouse gases. The skipper can adopt various measures to reduce fuel consumption and carbon emissions, by taking the appropriate actions and can substantially improve the fuel efficiency.

8. The Training Department of the Southeast Asian Fisheries Development Center (SEAFDEC/TD) has recognized the importance of climate change and reduction of energy use in fishing and has conducted several activities such as on-site training on improving energy saving for small fishing vessels in Southeast Asia region countries. This includes launching the corporate project on “Energy audit and FAO fishing vessel energy audit pilot project” (phase I and phase II). These projects have collected the baseline data and identified the potential of fuel saving in fishing

vessels. Parameters such as catch per liter of fuel and distance per liter during steaming and towing were collected in the pilot project. It enabled fuel use assessment for 6 trawl vessels in 3 size categories (small, medium and commercial) in the Gulf of Thailand and Andaman Sea. Energy audit leads to recommendations for improved efficiencies to mitigate present and possible future fuel cost increases.

The fishing sector is already experiencing issues such as overcapacity, overfishing and resource depletion. Fishing, and in particular bottom trawling, is an activity that requires much fuel. It also causes pollution that directly impacts marine resources, fishers' income and livelihoods. Some of the fishers had to stop fishing due to depletion of marine resources and high cost of fishing. The inefficient use of fuel also affects the profitability of fishing apart from the climate change. To reduce the burning of fossil fuel used in capture fisheries and increase the fuel efficiency (energy saving), including monitoring the fuel consumption, there is need of capacity building. In this connection, SEAFDEC/TD organized the regional practical training on fishing vessels energy audits (5 days) at SEAFDEC/TD.

IV. Objective of the Training

1) Enhancing the technical knowledge of the participants on the existing methods and techniques to improve fuel efficiency and fuel consumption monitoring in fishing activities;
2) Awareness building on responsible fishing, as well as on reduction of fishing vessel carbon dioxide gas emission through improving of energy efficiency (energy saving) in capture fishery;
3) Establishment of network on sharing technical information on optimizing energy used and fishing vessel energy audit for mitigating climate change effects.

V. Training Outcomes

1) The awareness and capacity of 16 participants raised to the level that can continue and replicate the skills on methods of energy audits and increasing fuel efficiency in fishing vessel operations;
2) Participants are able to transfer and utilize the technical knowledge and information on improving energy efficiency, energy audits, and engine maintenance etc. from training workshop for their future work;
3) The trained participants develop a clear plan of action for dissemination of the knowledge on energy audit and increasing fuel efficiency in fishing vessels in their respective countries.

IV. Method and Description

9. The training curriculum comprises of practice demonstration, presentations and discussion. The participants obtain basic and applicable knowledge on energy audit and ways to improve fuel efficiency used. Practical training on board is given for participants to measure the fuel consumptions of fishing in terms of fuel consumption rate. In addition, measures to reduce fuel consumption are demonstrated. The methods applied to training curriculum are as follows:

    1) Literature reviews: Presentations aiming at introducing technical information on the existing methods and techniques useful for improving energy efficiency (energy saving),

the fishing vessel energy audit method including views and ideas on increasing energy efficiency suiting Southeast Asia capture fisheries.

2) Practical/demonstration: Practical and demonstration sessions carried out. Participants can observe and hands on, as these experiences will improve their skill on ways to improve energy efficiency. Basic engine maintenance including the installation of fuel measurement are demonstrated and practiced at workshop, training vessel and sea trial test.

3) Discussion: This session included countries' presentations, clarifying, question and answer, and evaluation at the end of each topic which provided an opportunity to fulfill the participant understanding and sharing experiences and aimed to improve sharing information with resource persons and among the participants.

V. Participants and Training Personal

1) Trainers from SEAFDEC totally 4 persons
   - Four (3) from SEAFDEC/TD
   - One (1) resource person (former Head of Information and Training Division)

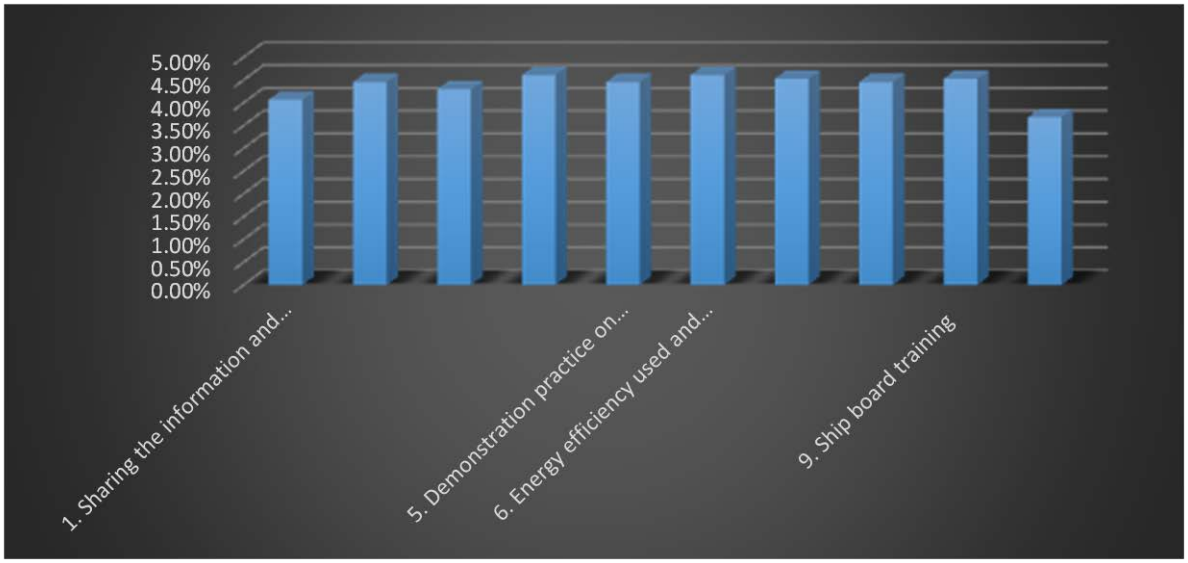
2) Participants14 persons in total

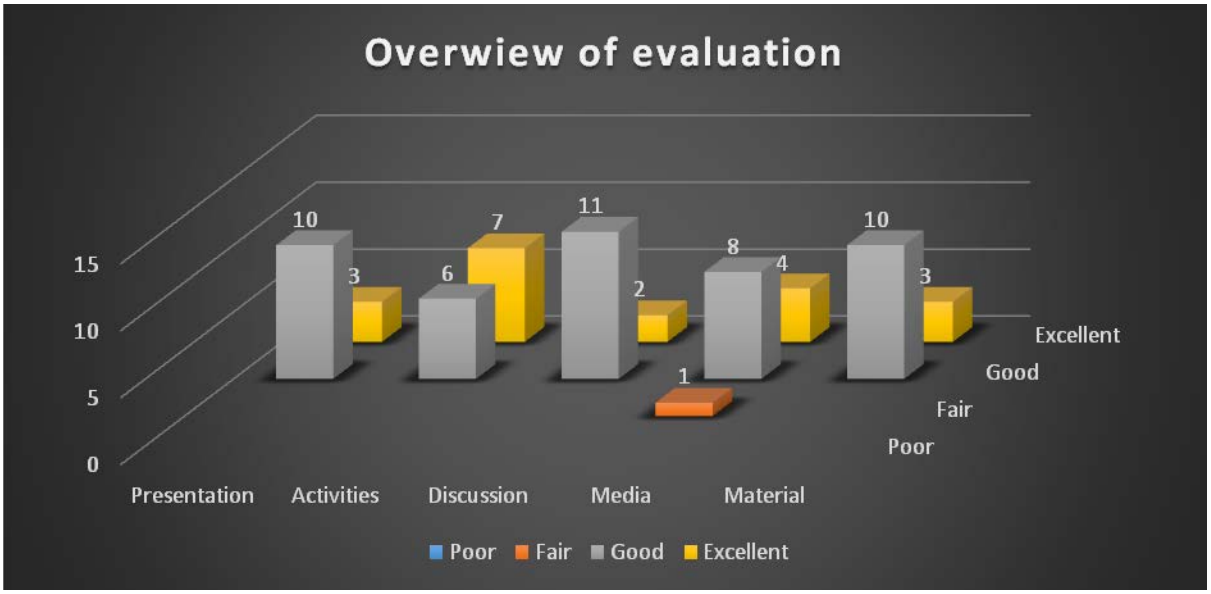
   REBYC Member countries
   - Three (3) Participants from Indonesia
   - One (1) Participant from The Philippines
   - Three (3) Participants from Thailand
   - Three (3) Participants from Vietnam

   Non-REBYC Member countries
   - Two (2) Participants from Malaysia
   - Two (2) Participants from Myanmar

VI. Evaluation and Conclusion of the Training

Topic	Score (1,2,3,4,5)
1. Sharing the information and recommendations for fishing vessels carbon emission	4.07%
2. Introductions to fishing vessels energy audits	4.46%
3. SEAFDEC and FAO fishing vessels energy audits for pilot project on Thai trawl vessels.	4.30%
4. Theory on basic engine maintenance, periodical checks and engine trouble shooting of marine engine	4.61%
5. Demonstration practice on basic engine maintenance, periodical check, trouble shooting, engine performance test for fuel consumption measurement	4.46%
6. Energy efficiency used and energy saving for fishing operation	4.61%
7. Optimising fuel efficiency through the implementation of gears design/materials/construction/fishing operation	4.53%
8. Practical training for installation of onboard equipment/tools for fishing vessels energy audits	4.46%
9. Ship on board training	4.53%
10. Results of Fishing vessel fuel audits for consumptions used and catch profile at sea trial tested.	3.69%





11. The overview of an evaluation from this practical training program on fishing vessel energy audits is made. Regarding the presentations including review of theory, principles and detailed information of each topics, almost all of the participants are satisfied as seen by results range good to excellent. It was also good to excellent for the training activities on both the lecture and practical sessions onboard. The items of discussion and analysis of data collected for fuel consumption almost all score 'good' and there are excellent scores too. For the training media and materials, this is rated good to excellent.

12. Referring to the results of evaluation, we can say that the practical training on fishing vessels energy audits was a great success. All participants were satisfied of the content and syllabus, (theoretical and practice) presentations, data analysis, training process, training materials / facilities, accommodation during the period of training, including training duration.

13. The difficulty during the training program was in the processing of data collected from the ship board training with the limited time. Beaing a short cruise, searching and reaching to good fishing ground was not realistic. The fuel consumption rate/emission to catch ratios was also not realistic as a usual fishing trip. The training just demonstrated on the principles, methods and procedures of fuel consumption monitoring during transit from port to fishing ground, fishing operation and back to port. However, the important key information is the ways to analyze the acquired data from fuel consumption and greenhouse emissions rate from vessel operation (MV PLALANG 1). This was conducted on the last day of training program. The result of data collection for different parameters on fishing vessel energy audit was compared between both types of equipment (analog fuel flowmeter and real time digital fuel flowmeter) was clarified and explained.

IX. Suggestions

14. **By participants:** The training program on fishing vessels energy audits should be promoted for various types of gears/vessels in future because of its importance for every country, which includes sharing technical knowledge, experience, applications, and application of technology in the field. It helps to improve fuel efficiency by both minimizing vessel operation cost and low level of greenhouse gas emission from capture fishery, Southeast Asia which burns lot of fossil fuel for capture fisheries is on the frontline with regard to impact of climate change. Measures for safety at sea and promoting fishing vessels operation resulting in low gas emissions are very important in this region.

15, **By engineering section head**: The most important factor in selecting a suitable fuel meter is determining the diesel feed and return rates at full power for the engine. Using this information, it is possible to select fuel meters with the correct range for the flows to be measured. Some diesel engines have negligible return flow rates and will only require installation of a single meter on the feed line. Diesel engines with significant return fuel flows may require fitting a second meter. The full-scale range of the second meter should match the maximum return flow expected. Fuel consumption is found by taking the difference between the two meter readings. Wheelhouse display, as well as considering the range of flow rate to use, the means of displaying the fuel consumption sensed must be considered as important. By-pass channel of some meters use moving parts/filtration that work by the flows of fuel. If such parts are jammed, then this could be a significant issue during engine operations. For this reason, it is recommended that inline fuel meters are installed with a by-pass valve.

Appendix 1. List of Participants and SEAFDEC Instructor

INDONESIA

1. Mr. Kun Budi Mugroho Nugroho
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MALAYSIA

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PHILIPPINES

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12.Mr. Tam Vu Van Staff	Central for Fishing Vessel Registration Directorate of Fisheries 10 Nguyen Cong Hoan Street Ba Dinh District Hanoi, Viet Nam Tel: 84 43 771 0295 E-mail: yvantam@gmail.com

INSTRUCTOR

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Appendix 2. Syllabus

Subject	Purpose
1. Information and recommendations for fishing vessels carbon emission	Sharing information and recommendations on current knowledge on energy efficiency and energy saving technology
2. Country presentation on the work/progress energy saving in fishing operation	Sharing experience in the region on applicable exiting methods and parameter on increasing fuel efficiency, fuel use measurement, monitoring and data collection
3. Introduction to fishing vessels energy audits for fishing operation	Introduce energy-audit process to suit certain types of fishing vessels. Way/method to undertake a trial, data collection for energy audit on fishing vessels for future work
4. Literature review on basic marine engine maintenance and systematic fuel measuring equipment for fishing vessels energy audits	Reviews on basic marine engine maintenance, periodical checks, installation of tools and systematic fuel consumption measures and monitoring for data collection
5. Demonstration practice on basic engine maintenance, periodical check, trouble shooting, engine performance test for fuel consumption measure	Enhance technical skills/views on basic engine maintenance, periodical check point, trouble shooting and engine performance test for fuel consumption measure at workshop
6. Demonstration and practice on installation of fishing vessels energy audits measuring equipment onboard	Enhance technical skills/views on installation of onboard equipment/tools for fishing vessels energy audits
7. SEAFDEC and FAO fishing vessels energy audits for pilot project on Thai trawl vessels.	Sharing the technical information and experiences on energy audits for fishing vessels
8. Increasing fuel efficiency through the use of appropriately designed gears / materials used in fishing operation	Sharing the technical information and experiences on energy/fuel efficiency using appropriate gears/fishing vessels operation
9. Sea trial test	Practical skills on improving fuel consumption measurement and data collection will done on board in different mode of fishing vessel operation
10. Discussion and Summary	Discussion/clarification including question and answer on the training subjects

Appendix 3. Course Timetable

January 23, 2017

0830-9000	Registration
0900-0930	Opening and group photo
0930-1000	Refreshment Break
1030-1100	Course/training program information
1100-1200	Sharing the information and Recommendations for fishing vessels carbon emission
1200-1300	Luncheons
1310-1430	Country presentation on the current situation on energy used and progress on the utilization energy used in fishing operation (20 min./country) for REBYC members.
1430-1500	Refreshment Break
1500-1600	Country presentation on the current situation of energy used and progress on the utilization of energy used in fishing operation (20 min./country) for non-REBYC members.

January 24, 2017

0830-1000	Introductions to fishing vessels energy audits
1000-1030	Refreshment Break
1030-1200	SEAFDEC anFAO fishing vessels energy audits for pilot project on Thai trawl vessels.
1200-1300	Luncheons
1300-1400	Theory on basic engine maintenance, periodical checks and engine trouble shooting of marine engine
1400-1430	Refreshment Break
1430-1600	Demonstration practice on basic engine maintenance, periodical check, trouble shooting, engine performance test for fuel consumption measure.

January 25, 2017

0830-1000	Energy efficiency used and energy saving for fishing operation
1000-1030	Refreshment Break
1030-1200	Optimization of fuel efficiency through the implementation of gears design/materials/construction/fishing operation
1200-1300	Luncheons
1300-1600	Practical training for installation of onboard equipment/tools for fishing vessels energy audits

January 26, 2017

0700	All participants onboard.
0700-0730	General information for training onboard *(Snack/Lunch will be provided onboard)*
0730	Leave SEAFDEC/TD

The practical training as schedule as following:

1. Leaving from shore to fishing ground
   - Monitoring for fuel consumption during voyage to fishing ground
   - Trial test with different speed and parameter
   - Data record for sea condition, current, wind direction etc,
2. Fishing/towing period
   - Trial test-monitoring for fuel consumption used with different speed and parameter.
   - Data recording for sea condition, current, wind direction etc,
3. Hauling operation
   - Data recording for catch information and fuel consumption used
   - Data recording for sea condition, current, wind direction
4. Drifting/steaming period
5. Leave fishing ground to SEAFDEC/TD
   - Trial test-monitoring for fuel consumption used with different speed and parameter.

1600 Arrive SEAFDEC/TD

January 27, 2017

0830-1000	Results of Fishing vessel fuel audits for consumptions used and catch profile at sea trial tested.
1000-1030	Refreshment Break
1030-1100	Conclusion for fishing vessels fuel audits Recommendation and clarification for future work.
1100-1130	Evaluation
1130-1200	Closing ceremony

Appendix 4. Opening Remark (SEAFDEC)

SEAFDEC Division Head,
Manager of Project UNEP GEF Fish Refugia,
Senior instructor,
All participants, SEAFDEC Staffs, Lady and Gentleman

Good morning

It is indeed a pleasure for me to be here and welcome you to the Practical Training on Energy Audits for Fishing Vessels organized by Project REBCY-II CTI and SEAFDEC supported by FAO and GEF

Before we start this meeting, I would like to extend our gratitude to the Regional Facilitation Unit of Project REBYC-II CTI and SEAFDEC Training Department in collaboration with our five Participating Countries, and Member Countries of SEAFDEC on assigning participants involved with the project and field of energy use in fisheries.

As you know, energy will become the most significant issue that impact fisheries and human well-being in fisheries industry. In the capturing process, the fuel cost obviously takes up majority of operational cost and directly decrease income of fisherman. The major concerns on the use of energy include excess-power of the main engine, heavy construction of wooden hull structure, lesser maintenance of the engine and machineries, and inappropriate fishing operations/practices. In the capturing process, the fuel cost takes up majority of operational cost, but we cannot find any alternative source of energy in near future.

Addressing the global concern on the climate change, includes the reductions of greenhouse gases, by reducing the source of pollution. The practical training deals with fuel efficiency measures that require minimum modification of their existing equipment to optimize energy use for fishing operation. It is therefore the practical training that aim to enhance the technical knowledge and awareness building of the participants on the existing methods and techniques to improve fuel efficiency and fuel consumption monitoring in fishing activities

We, in SEAFDEC, also expect that this practical training would be a success with expected outputs. I would like to express my sincere thanks to you, to FAO and GEF on the financial support and engineering division of SEAFDEC for their hard work to organize the practical training. With that, Ladies and Gentlemen, I now declare the Practical Training on Energy Audits for Fishing Vessels open.

Thank you very much and good day!

Appendix 5. Closing Remark (SEAFDEC)

On behalf of SEAFDEC, I would like to extend my sincere gratitude and express my appreciation to all of the successful participants in this training course. Ladies and gentlemen, during these 5 days training program, I do believe that you have gained a lot of knowledge, technical information, views and ideas on fishing vessel energy audit process.

Moreover, our organizing team members have designed this training course to focus on energy audit techniques which can be applied in fishing operation. I really hope that the technical information and knowledge which you have gained can be applied and made useful in your works. Subsequently, all such knowledge can be used as a tool to help the fishers improve fuel efficiency and reduce fishing vessel greenhouse gas emissions in your respective areas.

Once again, I would like to reiterate my gratitude to the FAO/GEF Project namely “Strategies for Trawl Fisheries By catch Management” (REBYC-II CTI), Mr. Christopher Patterson, and the SEAFDEC staffs who worked hard for implementation of this training course. I thank the participants especially for your valuable contributions and your active participation during this training. I would expect that the achievements of this training course can strengthen the skills and knowledge of all participants as well be useful to your country afterwards Ladies and Gentlemen, may I now declare this training closed, and may I wish you all good luck and health. Thank you very much again and have a good day!

Appendix 6. Photos from the training course

Participants were informed on the current situation on energy use and progress on the utilization of energy used in fishing operation

Sharing the information and recommendations for fishing vessels carbon emission, by Mr.Bundit C.

Practical training for installation of onboard equipment/tools for fishing vessels energy audits

Data recording for catch information and fuel consumption practice

Participants embark and preparation for ship board training

Trial test with different speed and parameter and
data record for sea condition, current, wind direction etc.

Monitoring for fuel consumption during trawl fishing operation

Recording the fuel consumption rate/emission to catch ratios practice

Appendix 7. Information on training vessel

1) Training vessel profile

Name of vessels	**MV.PLALANG 1**
License No.	317402779
Construction Material	Wooden
Length Overall	17.5 m
Length Water line	16.10 m
Breadth	4.80 m
Draft	1.8 m
Gross Ton	35.46
Net Ton	24.11
Main Engine	Diesel (HINO K 13 D)
Engine Number	A 11644
Cylinder	6
Brake horsepower	150 KW.
Owner	SEAFDEC/TD

2) Chart of the route and location

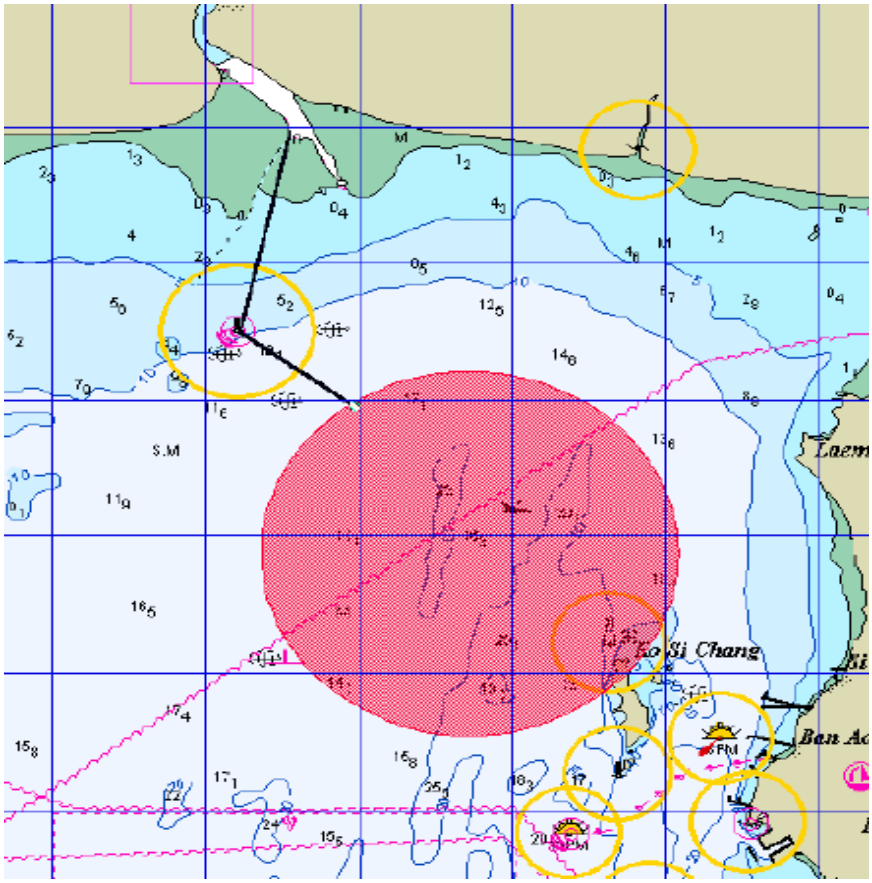
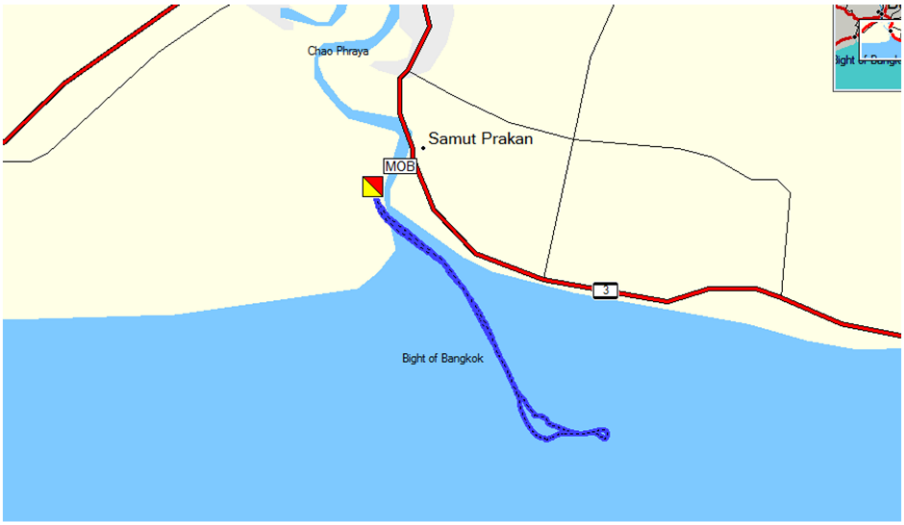


Chart on the route and location of training vessel Cruise No. 188-2/2017

Results from GPS navigator



3) Fuel consumption profile

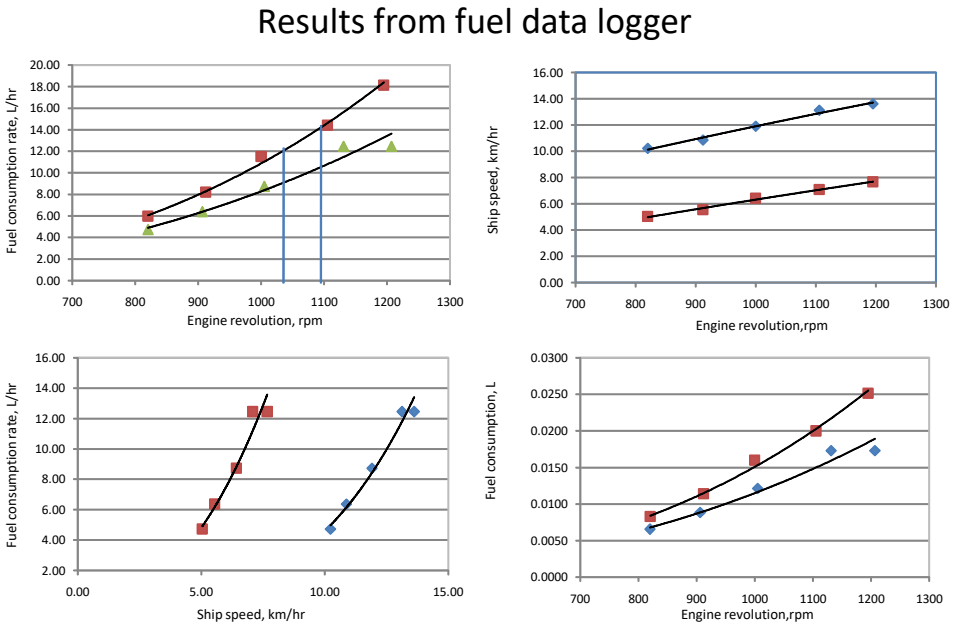
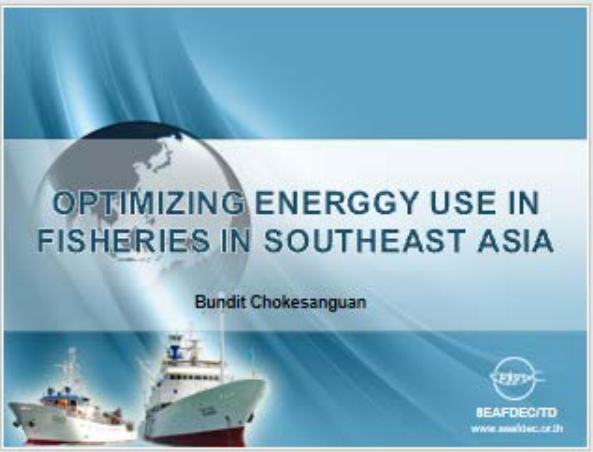


Chart of fuel consumption on training vessel at various parameter

Appendix 8. Presentation of SEAFDEC

1. Optimizing Energy Used in Fisheries in Southeast Asia



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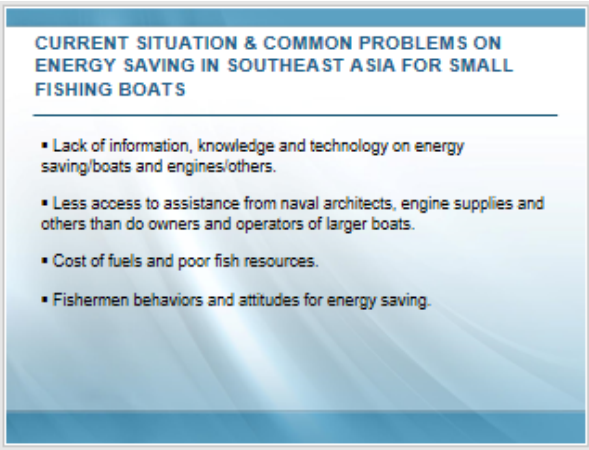

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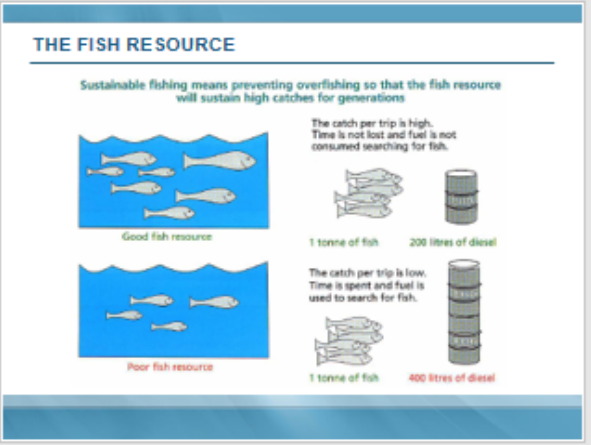

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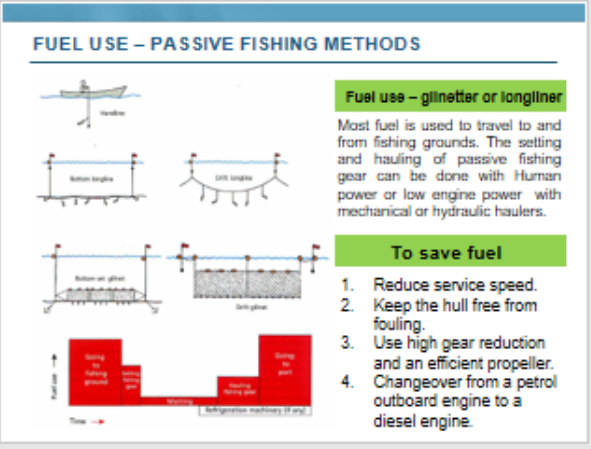

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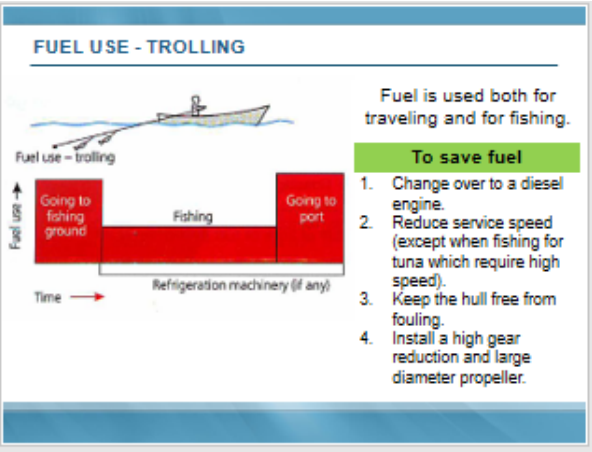

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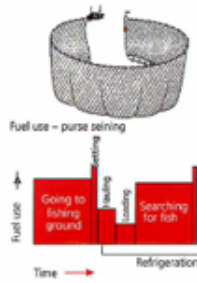
FUEL USE – PURSE SEINING



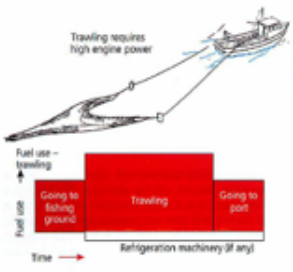
Most fuel is used going to and from fishing grounds and searching for fish.

To save fuel

1. Reduce service speed.
2. Install advanced fish-finding equipment.
3. Keep the hull free from fouling.
4. Install a high gear reduction and large diameter propeller.

7

FUEL USE -TRAWLING



Most fuel is drag the trawl along the bottom (bottom trawling) or above the bottom (pelagic trawling). Reduction power going to and from fishing grounds saves fuel.

To save fuel

1. Modify the trawl and trawl boards.
2. Install the highest gear reduction available and a large diameter propeller with a propeller nozzle (depending on stern aperture).
3. Install advanced fish-finding equipment.
4. Consider a changeover in fishing method to pair trawling or Danish seining

8

WAY & MEANS OF REDUCING THE USE OF FOSSIL FUEL IN FISHERIES

- Hull design
- Engine power and operation range
- Engine design
- Engine operation and maintenance
- Modification of fishing gear and methods
- Improvement of fish handling and post-harvest technology onboard fishing boats (Minimizing the fuel consumption for refrigeration/auxiliary engine through good fish handling processes and presentation)

9

WAYS & MEANS OF REDUCING THE USE OF FOSSIL FUEL IN FISHERIES

- Alternative fuel use
  - LPG
  - LNG
  - CNG
  - Ethanol
  - Hydrogen
- Alternative energy use
  - Wind
  - Solar
  - Wave Energy

10

LIST OF SEAFDEC PROJECTS

- **ENERGY USE IN FISHERIES IN SOUTHEAST ASAIN :** Promotion of Sail Fishing Boat for Small-scale Fisheries
- **SEAFDEC-FAO ENERGY AUDITS**
- **OPTIMIZING ENERGY USE IN SMALL FISHING BOAT FOR FISH HANDLING**

SEAFDEC/TD www.seafdec.or.th 1

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ENERGY USE IN FISHERIES IN SOUTHEAST ASAIN :

Promotion of Sail Fishing Boat for Small-scale Fisheries

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ENERGY USE IN FISHERIES IN SOUTHEAST ASAIN :
Promotion of Sail Fishing Boat for Small-scale Fisheries

INTRODUCTION

Promotion of Sail fishing boat was conducted in 2008

Collaboration with

13

ENERGY USE IN FISHERIES IN SOUTHEAST ASAIN :
Promotion of Sail Fishing Boat for Small-scale Fisheries

OBJECTIVES

1. To assist local fishermen to reduce costs and increase revenue for small-scale fisheries;
2. To reduce fuel consumption, which is a major problem in the economy;
3. To improve technical support on utilize of wind energy for poverty elevate of local fishers without overheating the climate;
4. To transfer appropriate ship stability improvement and technique used; and
5. To introduce view and idea of small-scale fishers utilize of wind energy for fishing.

14

ENERGY USE IN FISHERIES IN SOUTHEAST ASAIN :
Promotion of Sail Fishing Boat for Small-scale Fisheries

ACTIVITIES

- To give knowledge all important part in using sailboat for fishing;
  - Installation of the sail's materials in small-scale fishing boats
    - e.g.
      - sail construction
      - boom installation
      - arrangement of sail cloth
      - installation of mask
      - calculation for size of the sail cloth
      - etc.
  - Types of lines & knots using for sailing; and
  - Sailboat safety operating procedure
    - e.g.
      - wind and weather affecting the sail
      - sailing techniques
      - safety onboard of sail boats
      - sitting position on board
      - etc.
- Demonstration, Practical Training, and Experiment on the use of sailboat

15

ENERGY USE IN FISHERIES IN SOUTHEAST ASAIN :
Promotion of Sail Fishing Boat for Small-scale Fisheries

PROMOTION OF SAILBOAT

16

SEAFDEC-FAO ENERGY AUDITS

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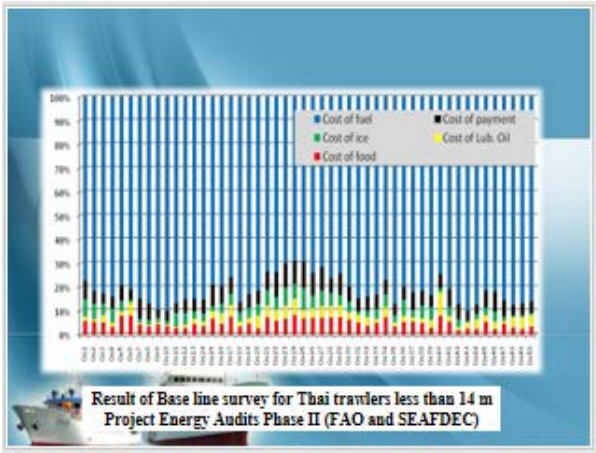
SEAFDEC-FAO ENERGY AUDITS

OBJECTIVES

1. Estimation of fuel consumption and CO_2 emission of fishing vessels
2. Assessment of the use of fuel consumption in fishing operation through impact to fishermen

18



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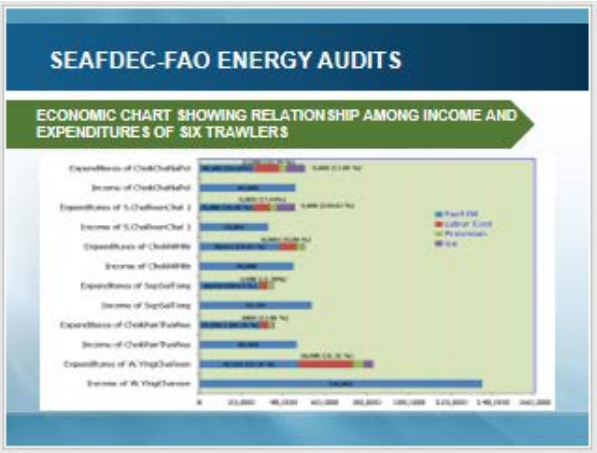

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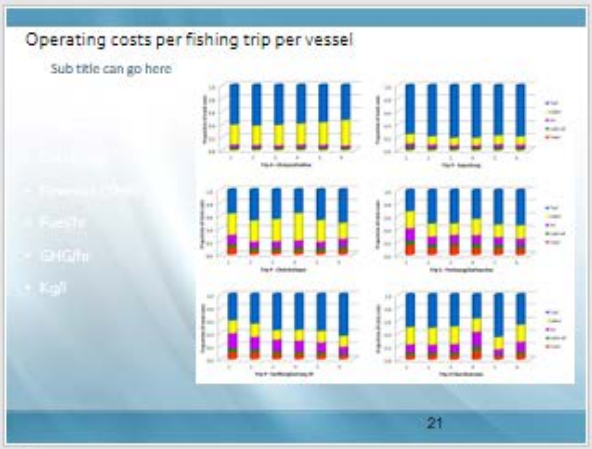

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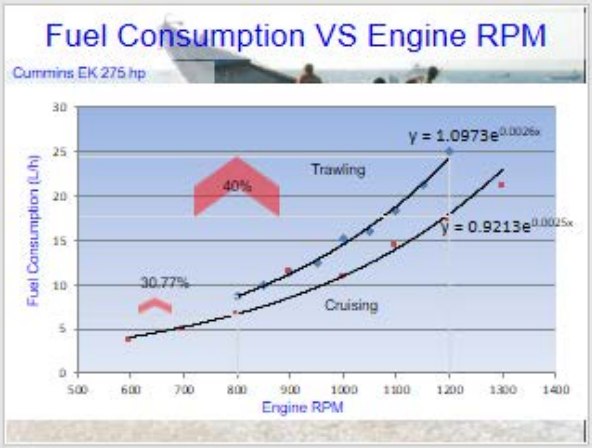

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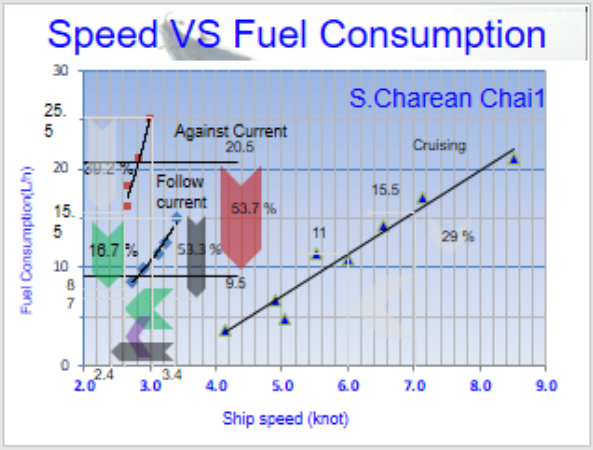

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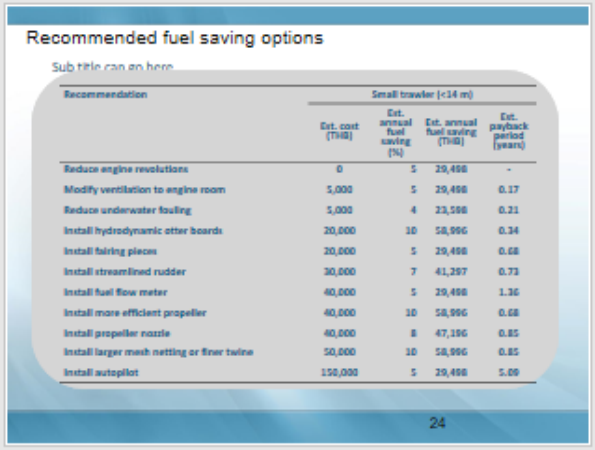

Recommendation	Small trawler (<14 m)			
	Est. cost (THB)	Est. annual fuel saving (%)	Est. annual fuel saving (THB)	Est. payback period (years)
Reduce engine revolutions	0	5	29,400	-
Modify ventilation to engine room	5,000	5	29,400	0.17
Reduce underwater fouling	5,000	4	23,500	0.21
Install hydrodynamic otter boards	20,000	10	58,996	0.34
Install fairing pieces	20,000	5	29,400	0.68
Install streamlined rudder	30,000	7	41,297	0.73
Install fuel flow meter	40,000	5	29,400	1.36
Install more efficient propeller	40,000	10	58,996	0.68
Install propeller nozzle	40,000	8	47,196	0.85
Install larger mesh netting or finer twine	50,000	10	58,996	0.85
Install autopilot	150,000	5	29,400	5.09

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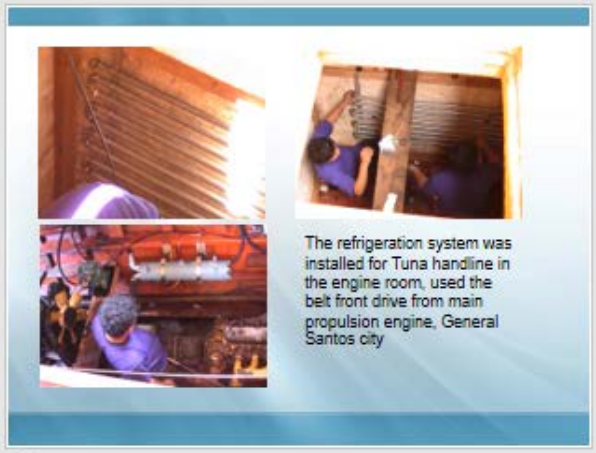

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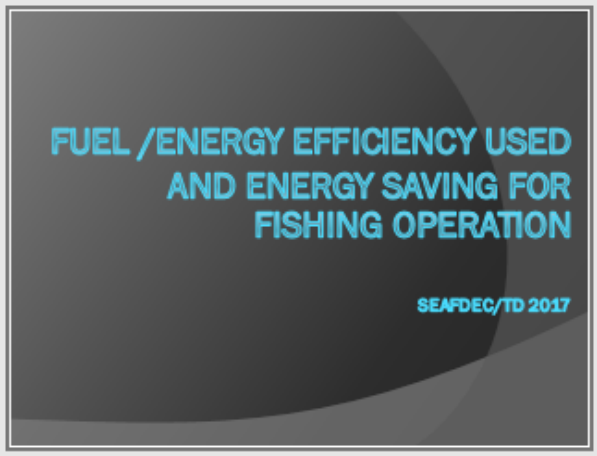
2. Fuel/ Energy Efficiency Used and Energy Saving for Fishing Operation



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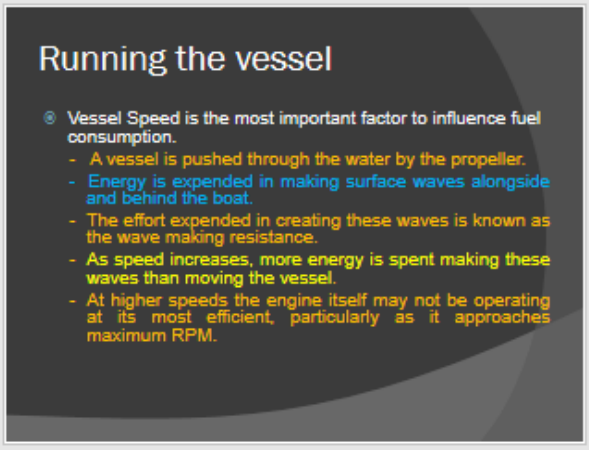

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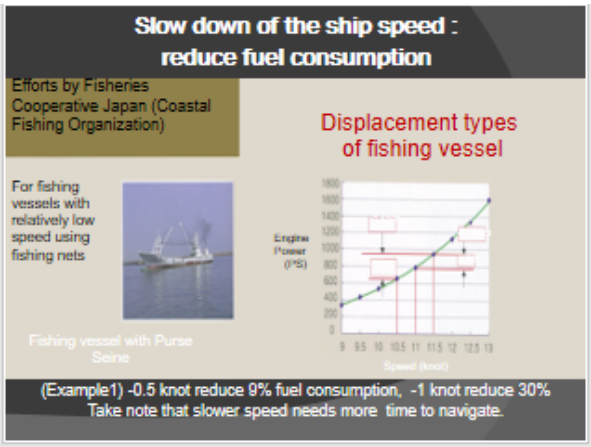

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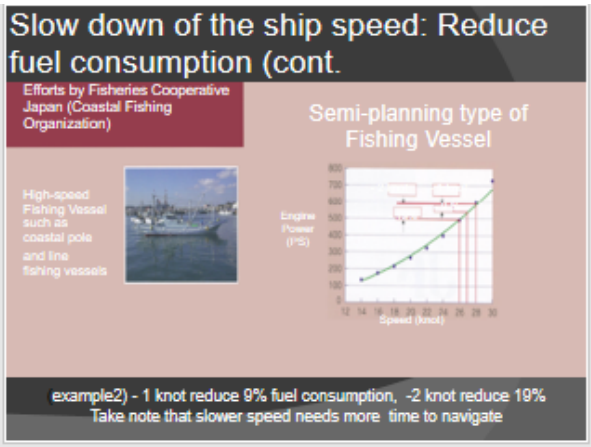

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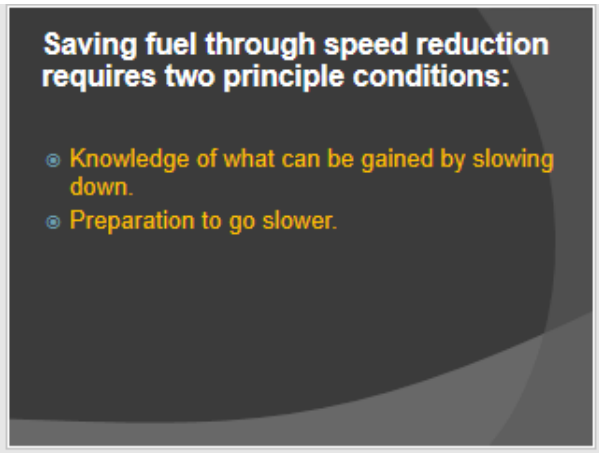

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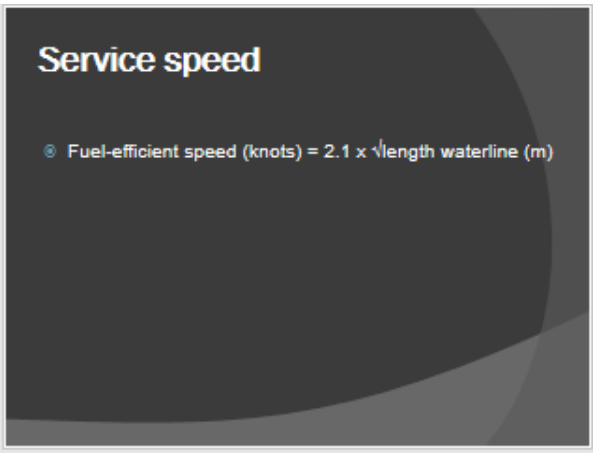

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Factors involved in slowing down:

- The vessel slows down and the journey takes longer.
- The efficiency of the engine will change, but it will consume less fuel per hour.
- The resistance of the hull in the water drops rapidly.
- The efficiency of the propeller changes.

7

Fuel Monitoring (Flow meter)

- A fuel meter is your tool to help you track consumption. Keep a log of what your consumption is during different operating conditions. A fuel monitor will:

FloScan Meter General purpose for midsized Engines. Price range: $1,200 to $1,700

Mid Range Meter Can give hourly rates. Can give trip consumption. Price range: $700 to $1,200

8

A fuel monitor will:

- Provide you with fuel consumption information
- Help you change your fuel consumption habits
- Help you monitor how changes in displacement and trim affect fuel efficiency
- Help you modify your actions to get the most out of your specific boat and engine

9

The energy that reaches to the propeller.

- 35% is used to turn the propeller
- 27% to overcome wave resistance
- 18% to overcome skin friction
- 17% to overcome resistance from the wake and propeller wash against the hull
- 3% to overcome air resistance

10

Engine Maintenance

- Perform regular maintenance
  - Change oil, filters and separators regularly.
  - Make daily inspections of the shaft, bearings, couplings and stuffing box for increased vibrations, dirty filters and sufficient lube.
  - Follow the engine manufacturer's maintenance program.
  - Entrust complicated mechanical work to a qualified mechanic.
  - Run in a new or reconditioned engines carefully.

11

Engine maintenance is required

- **Black exhaust smoke indicating: an overloaded engine; a shortage of air; or worn injectors.**
- **White exhaust smoke indicating: mistimed injectors/ valves; leaking inlet or burnt exhaust valves; damaged/ worn piston rings; low compression; or exhaust back pressure.**

12

Engine maintenance is required

- **Blue exhaust smoke indicating: oil in the combustion:** chamber indicating either worn valve guides or worn/ broken piston rings; or oil in the exhaust side of a turbocharger following seal failure.

13

Hull Maintenance

- SMOOTH THE BOTTOM

The causes of increased skin friction can be placed in two categories:

- **Hull roughness resulting from age deterioration of the shell of the hull or poor surface finish prior to painting.**
- **Marine fouling resulting from the growth of seaweed, barnacles etc. on the hulls underwater surface.**

14

Savings can be made by: Clean

- Cleaning under water hull surface, the propeller and rudder can result in very significant savings.
- The effectiveness of any antifouling paint that has been applied.
- Local environmental conditions, especially water temperature. (i.e. the warmer the water, the faster weeds grow)

15

Clean ship hull, rudder and propeller

- Hull, rudder, propeller and other parts get dirty due to the attached algae, shellfish making it difficult to sail at predefined speed because of increased friction drag which also increases the fuel consumption. Cleaning periodically (about 6 months) is recommended.



16

Keep It Clean

- Fouling can increase fuel consumption by 7% after only one month, and 44% after six months!
- Antifouling paints range from cheaper, harder paints to more effective and more expensive hydrolyzing or self-polishing paints.
- Self-polishing antifouling paints become smoother over time and can offer reasonable protection from fouling for up to two years, but the paint system is expensive to apply and requires complete removal below the waterline of all previous paint.

17

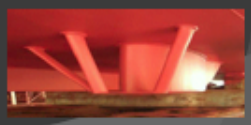
Fairing (Lower the friction)

- The amount of effort spent on hull maintenance should consider:
  - The speed of the vessel, the faster the vessel the more important the surface condition of its hull.
  - The rate of growth of fouling or deterioration of hull surface.

18

Appendages

- Anything attached externally such as sonar domes, external heat exchanger pipes, and shaft struts, affects the flow of water around the hull. This can create significant pressure changes, leading to increased vessel resistance.



Low Resistance Cover for echo sounder

19

Appendages

- Consider using internal heat exchangers.
- When adding anything to the hull ensure that all shape changes are gradual, and "faired in" minimizing pressure changes.
- Ensure that all struts are always submerged to avoid air suction. This is especially important for shafts near the propeller to optimize propeller performance.
- Stern posts should be faired to a point in order to let the water flow to slip off the end of the hull forward of the propeller. This will avoid high drag forces.

20

Appendages

- A squared off stern post will result in significant eddies being formed which when entering the propeller can create several problems including significant reduction in propulsive efficiency.
- *Only install underwater appendages when absolutely necessary.*

21

Ghost Weight

- Excess weight accumulates on-board vessels over time. This can include spare parts, partially used products, waste, dirt, and excess ballast.
  - Perform regular bow-to-stern cleaning.
  - Remove rarely used equipment. When replacing old equipment consider lighter products.

22

Trip Planning

- Getting to know the tides and currents in the area that you travel can save you time and fuel.
  - Keep tide and current books handy.
  - Look for currents and eddies to gain speed.
  - Keep a straight course, point to point.

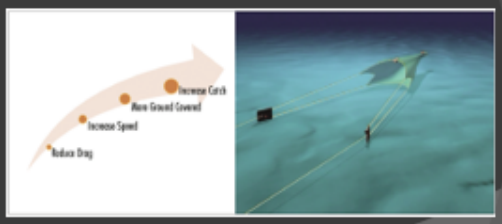
23

Fishing

- More efficient gear may increase productivity and catch rates, while reducing energy costs. Audit your system to discover areas where you can reduce drag and fuel consumption. Monitoring gear during operations should be considered.

24

Efficient fishing



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Ways to reduce drag

- *Over 60% of all resistance comes from the drag on the netting while fishing*
  - Reduce the amount of netting surface.
  - Increase mesh sizes.
  - Decrease twine sizes.
  - Introduce super fibers.
  - Add a net monitor to audit fishing operations.

26

Propulsion

- The propulsion system needs to be tuned for efficiency, matching propeller to gear, engine size and hull design.

27

Signs of a faulty propulsion system

- **Abnormally low steaming speed vs. RPM compared to** similar vessels.
- **High levels of vibration not attributed to engine, generators** or other on-board machinery.
- **Little or no gain in vessel speed with significant RPM** increase.

28

Signs of a faulty propulsion system

- **Engine unable to meet target RPM.**
- **Black smoke expelled through exhaust.**
- **Chronic blade damage not resulting from striking underwater** objects.

29

Propellers

- Propeller design and specifications have a direct influence on vessel fuel efficiency. It is important that propeller technical specifications be entrusted to a qualified professional.

30

Factors affecting propeller efficiency:

- ***The diameter of the propeller is the most important single factor in*** determining propeller efficiency.

  The diameter of the propeller should be as large as the hull design and engine allow.

31

Factors affecting propeller efficiency:

- **Shaft Speed The larger the diameter of the propeller, the slower the** shaft speed RPM required to absorb the same power.

  The gearbox ratio should be chosen to give a proper RPM at the propeller efficiency

32

Factors affecting propeller efficiency:

- **Cavitations results when excess bubbles form around the propeller.**

  This problem is a result of a poorly designed or mismatched propeller. In the long run, the effects of cavitations will increase fuel consumption.

33

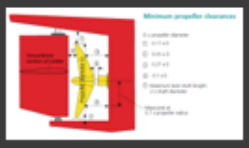
Factors affecting propeller efficiency

- **Number of blades** In general the fewer blades a propeller has, the better. However the trade-off is that each blade carries more load which can lead to increased vibration and contribute to cavitations. When the diameter of the propeller is limited by the size of the aperture, it may often be better to keep shaft speed low and absorb the power through the use of more blades.

34

Factors affecting propeller efficiency

- **Propeller clearances. The distances between the propeller and the hull affect** how efficiently the propeller operates within the flow of water around the hull, and the vibration caused by the propeller.



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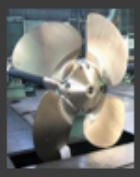
Energy efficiency used by adoption of new technology

Kinds of Technologies

1. **Energy saving supported by software**
2. **Energy saving by remodeling the hull**
3. **Energy saving by remodeling the engine**
4. **Energy saving with improved fishing gears and machines**

36

Energy saving supported by software



- Use of the controllable pitch propeller
- Adopt electronic engine control for stabilizing fluctuation of engine load

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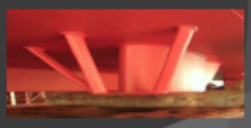
Energy efficiency used by the remodeling of the hull

Bulbous Bow

Fins

Appendage

New Type Bilge Keel to streamline water flows



Low Resistance Cover for echo sounder

38

Energy efficiency used by remodeling the engine

- Replacement of the engine, reduction gear, propeller
- Main engine-driven generators and auxiliary machinery (using power take off)
- Control of number of revolutions of such as pumps by the inverter/soft starter

39

LED Fishing Lights

Adopt LED,

- Low consumption in electricity & fuel
- No need for Stabilizer
- Power supply ON/OFF is possible in real time
- Brightness of the light is adjustable.
- Long life and durable

40

Slurry-ice

Source: NISSIN REFRIGERATION & ENGINEERING Co. LTD.
日新興業株式会社

41

Slurry-ice contained in the tank of a fishing boat

資料: NISSIN REFRIGERATION & ENGINEERING LTD.

42

Look for ECR...

What is ECR ?

43

9

Energy Consumption Rate (ECR)

$$ECR = \frac{\text{Energy Consumption (liter)}}{\text{Fish Catch (kg)}}$$

ECR 1: 100 liters/1200 kg =0.08

ECR 2: 150 liters/1200 kg =0.125

ECR 1: 0.08 liters used for catch 1 kg of fish
ECR 2: 0.125 liters used for catch 1 kg of fish

44

Conclusion

- These are an option of ways to achieved:
  - Increase the efficiency of the power plant through the use of more efficient engines and generator.
  - Remodel the design of hull and propellers to reduce resistance and increase efficiency.
  - Reduce vessel speed to improve fuel efficiency without costly additional equipment.
  - Install an electronic fuel meter to help monitor fuel consumption and establish an optimum steaming speed.

45

Conclusion

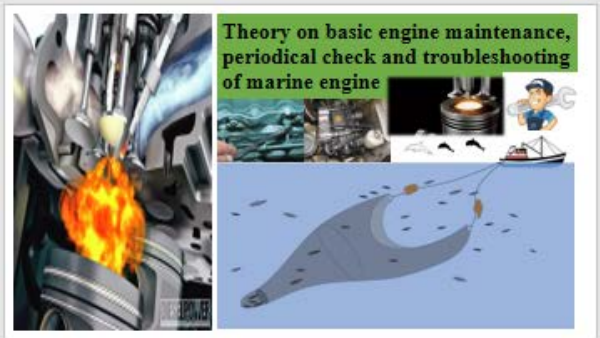
- Remove excess weight to lighten up the boat and significantly reduce fuel consumption.
- Regularly maintain the vessels hull and engine to reduce drag and enhance engine performance.
- Shift to low fuel (passive) fishing techniques such as static gear or seine netting.
- Use alternative fuels such as liquefied natural gas, wind power, bio-fuels and solar energy. The oxides of sulphur emissions from Bio-Diesel are at least 80% lower than low sulphur fossil diesel.

46

Thank you for your attentions

47

3. Theory on Basic Engine Maintenance Periodical check and Trouble Shooting of Marine Engine



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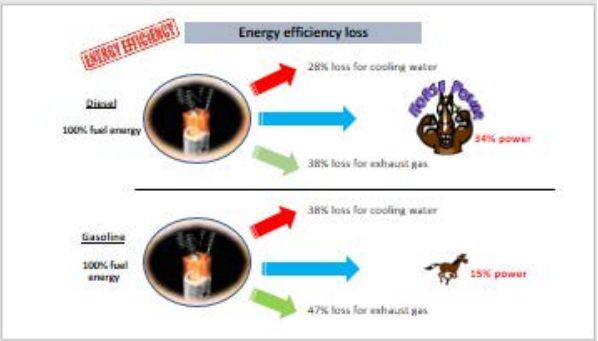

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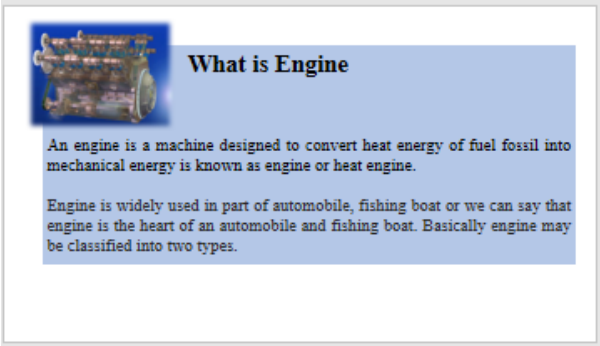

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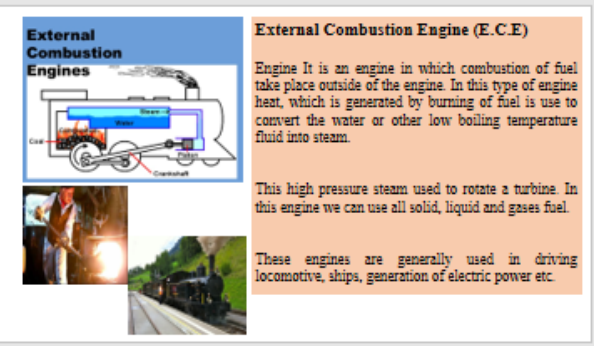

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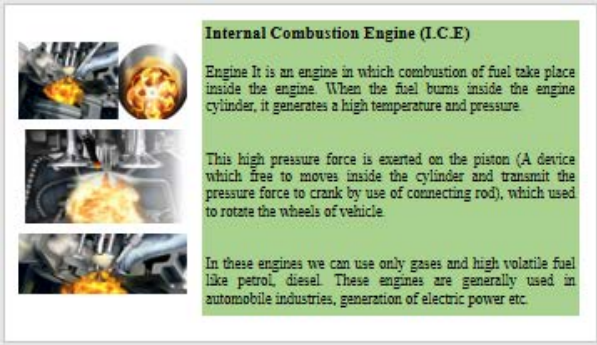

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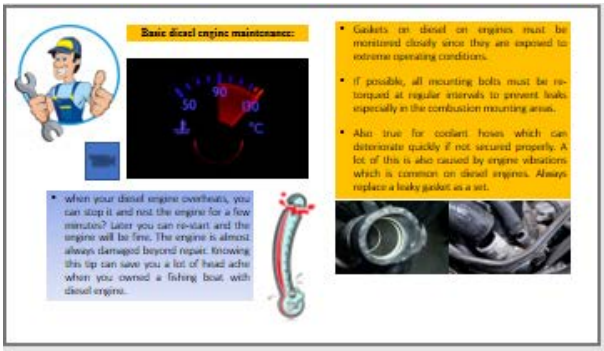

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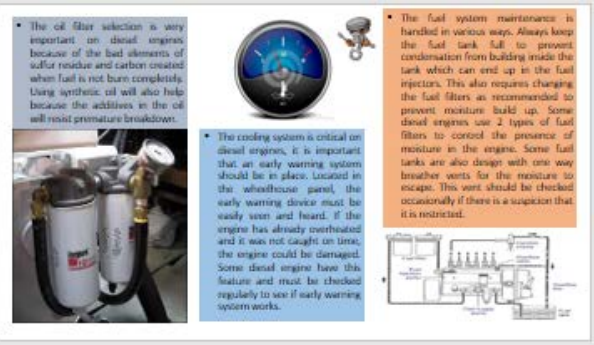

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- Diesel engine has very carbon monoxide. However, it produces a lot of black soot which is the result of incomplete combustion. Most of this is caused by dirty injectors and faulty injection timing that inject too much fuel. To ward this off, glow plugs are used to heat the combustion chamber to assist in burning the fuel. These glow plugs must be checked especially before winter season.

.....With the cost of fuel rising with no end in sight, diesel engine is a good alternative more than gasoline engines that must be considered. Knowing the basic diesel engine maintenance is essential if you want to save money in fishing boat operation and cost.....



9 ★

Cooling System

Function of cooling system
- Maintain proper engine temperature for optimum performance
- Dissipates excess heat from other machine system
  - Engine
  - Transmission
  - Hydraulic
- Cools compressed inlet air to optimize combustion

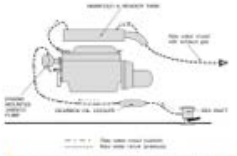
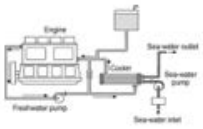
Cooling systems are designed to keep an engine operating within a temperature range. The temperature of the coolant must remain high to allow the engine to operate efficiently. However, the temperature must stay low enough to prevent the coolant from boiling.

Check the coolant level during shutdown periods at the specified interval. Remove the radiator cap after allowing the engine to cool, and, if necessary, add coolant until the level is about 3/4 in.

Be very, very careful if the engine is hot. You may get a spurt of steam or near-boiling water: cover the filler cap with towels to minimize the risk!




10 ★

Some engines use sea water (usually called raw water) to cool the engine directly. Sea water enters the system through a seacock and strainer, and is pumped through passages in the engine block and cylinder head to absorb heat, before being mixed with the exhaust gas in the "injection bend". As it mixes, it cools the exhaust gas, so that the water/steam/exhaust mixture can pass safely through a flexible hose and out of the boat.

In the enclosed system, the water that flows through the engine's water jacket and ports is the fresh water and coolant. The only part the raw water flows through is the heat exchanger. The same scaling occurs however. When water flow is restricted and the engine begins to overheat you may be able to "acid boil" the scale out of the heat exchanger and continue to use it. The worse case is that you would have to replace the heat exchanger. This would be much less expensive than replacing the engine.

11 ★

How to check ???

Check drive belts
If you suspect overheating, the first thing to check (because it's easy to do, rather than because it is particularly likely) is to make sure the belt that drives the raw water pump hasn't broken. If it has, the only solution is to replace it. The principle is exactly the same as replacing the fan belt on a car, but the details vary a lot from one engine to another.

Check raw water is coming in
The next check is that the seacock is open and that the strainer is clear. Again, strainer designs vary, but in general, the procedure is to shut the seacock, unscrew the top of the strainer body, remove the strainer element, rinse it, and reassemble the whole thing. Remember to open the seacock afterwards!

Check coolant levels
Do not check the coolant level, if the engine is hot! And Be very, very careful if the engine is hot. You may get a spurt of steam or near-boiling water: cover the filler cap with towels to minimize the risk!

Example case:
- overheat gauge or alarm
- lack of water from exhaust
- steam in engine compartment
- loss of power
- rough or uneven running
- engine stops



12 ★

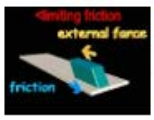


Check the thermostat
The other common problem with fresh water cooling systems is the thermostat. This restricts the flow of coolant when the engine is cool, so as to let it warm up quickly.

A broken impeller with a missing blade

Very carefully touching some engine parts can help determine if there is excessive heating in places that should be cool.

13 ★

Lubrication System

Lubrication is a process which aims at reducing friction between two moving pieces. When two surfaces come in contact with one another, a fluid must be injected to separate them. The word « greasing » applies when grease is used to lubricate.

The engine oil must be checked while shutting down the engine at regular intervals using a dipstick. Allow the oil in the upper portions of the engine to drain back into the crankcase and follow the engine manufacturer's recommendations for API oil classification and oil viscosity.

What are the main purposes of lubrication?
Lubrication allows to:
- Reduce friction (rubbing or deformation)
- Prevent pieces from wear
- Absorb/reduce shocks
- Protect from corrosion
- Isolate components from contamination
- Clean/get rid of contaminants.

14 ★

Friction

Force that opposes motion between two surfaces in contact

When one body slides a across another a resistive force must be overcome

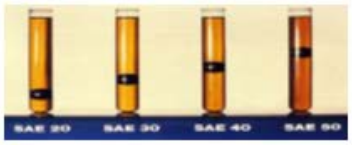
15 ★

Lubrication

Purpose of oils

Oil reduce friction between moving parts
- Lubrication – slippery surface between moving parts
- Seal – between piston ring and cylinder surface
- Cool – especially bearing
- Clean – contaminates held in suspension

Change oil before winter lay-up so contaminates are removed and do not damage the machine during storage

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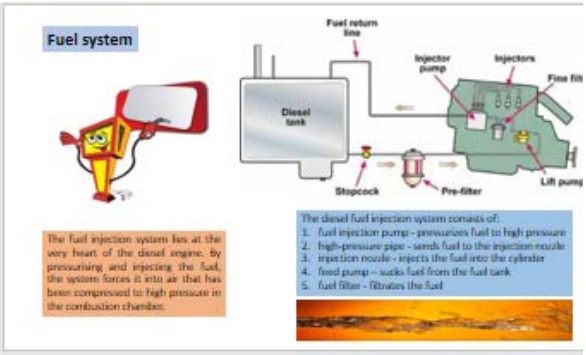

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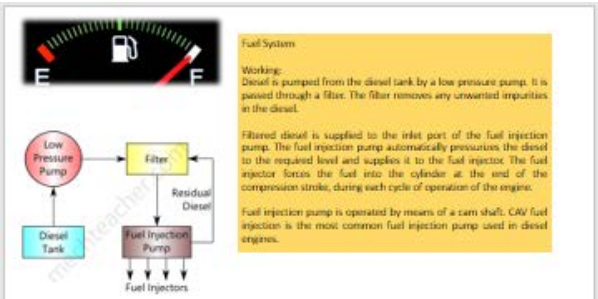

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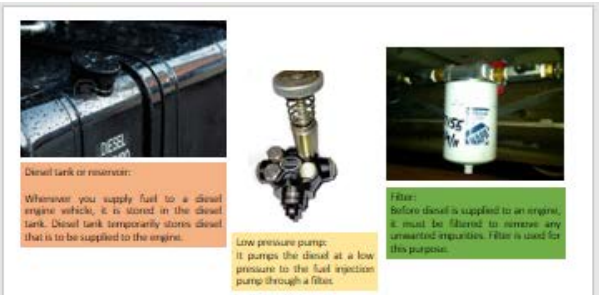

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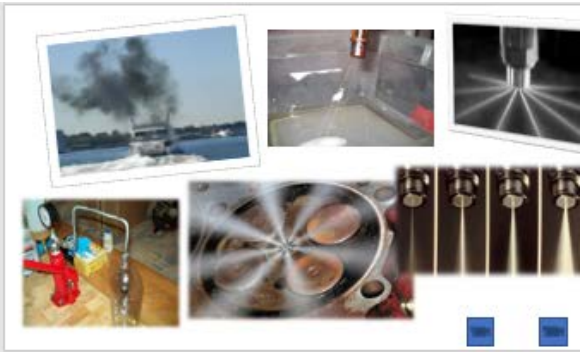

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Causes of Fuel problems

DIRT IN FUEL SYSTEM

Many diesel engine operating troubles result directly or indirectly from dirt in the fuel system. That is why proper fuel storage and handling are so important. One of the most important aspects of diesel fuel is cleanliness. If fuel dirty, fuel pump and injector troubles will occur in Diesel fuel system. Because it is more viscous than gasoline, will hold dirt in suspension for longer periods. Therefore, every precaution should be made to keep the fuel clean.

WATER IN FUEL SYSTEM

Water can get in Fuel so many ways, even if you get dry clean fuel, your tank system is vented (unlike a car) and the vent will let in humidity. Water also condenses on the tank walls due to temperature fluctuations, especially true in winter. The more air in the tank the more condensation. Its recommended that you keep your tanks up to 95% full to combat this

Dirty System Clean System

25 ★

Fuel clogging can be a problem. It always seems to happen at the worst time. You are in rough water and the motion stirs up the sediment in the tank and the filter gets clogged. You need to shut down the engine but you are in a nasty channel and need the engine.

AIR IN FUEL SYSTEM

Air trapped in diesel fuel systems is one of the main reasons for a hard starting engine. Air can enter the fuel system at loose joints in the piping or through a spray nozzle that does not close properly. Letting the engine run out of fuel will also cause air to enter the system. Like water, air can interfere with the unbroken flow of fuel from the tank to the cylinder. A great deal of air in a system will prevent fuel pumps from picking up fuel and pushing it through the piping system. Air can be removed by bleeding the system by technician.

26 ★

CLEANING INJECTORS

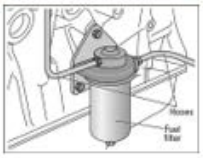
Injector spray nozzles or pumps should be disassembled in the field only when no other recourse is available. Whenever possible, they should be removed from the equipment and brought to the shop for repair. The first requirement for the cleaning job is a clean working area.

Filling with the wrong Fuel. Gasoline in a Diesel Fuel system is disastrous and could involve the risk of explosion, so make sure the fillers say Diesel only.

27 ★

Diesel Fuel maintenance

- Clean Fuel tanks
- Filter fuel as it comes aboard
- Keep Water OUT
- Separate water from Fuel
- Filter fuel before it gets to engine
- Polishing Fuel systems onboard



Clean Fuel tanks

Inspect your tank and if you have any doubts clean it.

Filter Fuel as it comes aboard

Buy Fuel from a reliable source, the you can be confident in. If you hav an source unknown to you check th fuel. Pour some fuel in a containe and let it settle. Water and dirt w settle to the bottom. If you s either, filter the fuel before it go into the tank, or better yet, buy you fuel somewhere else.

CLEAN FUEL

28 ★

Keep Water Out

H20 out

We know that if you leave a boat for a long period that you should fill up the fuel tank. This reduces the chance of condensation as there is less room for air. Air forms condensation and the water produced gets into the fuel.

Separate water from Fuel

Filter fuel before it gets to engine

29 ★

Fuel Filtering

Fuel filtering and polishing are different. Filtering happens as fuel is supplied to the engine, polishing can be done at anytime and fuel is fed to the polishing unit and then back to the tank, so its clean and ready for the engine.

Many boats have more than one filter between the engine and the tank. The filter on the engine is know as the secondary filter and the engine manufacturer expect that only very small contamination is going to get to this point.

The vessels primary filters do the most work and remove water & contaminates from the fuel. These primary filters should have clear bowls underneath, which make it easy to see what's going on. You can drain the bowl when necessary.

30 ★

Testing Batteries

Weak or undercharged starting batteries are a common cause of standby power system failures. The battery must be kept fully charged and well-maintained to avoid dwindling by regular testing and inspection to know the current status of the battery and avoid any start-up hitches of the generator. They must also be cleaned; and the specific gravity and electrolyte levels of the battery checked frequently.

Testing batteries: Merely checking the output voltage of the batteries is not indicative of their ability to deliver adequate starting power. As batteries age, their internal resistance to current flow goes up, and the only accurate measure of terminal voltage must be done under load. On some generators, this indicative test is performed automatically each time the generator is started. On other generator sets, use a manual battery load tester to attest the condition of each starting battery.

31 ★

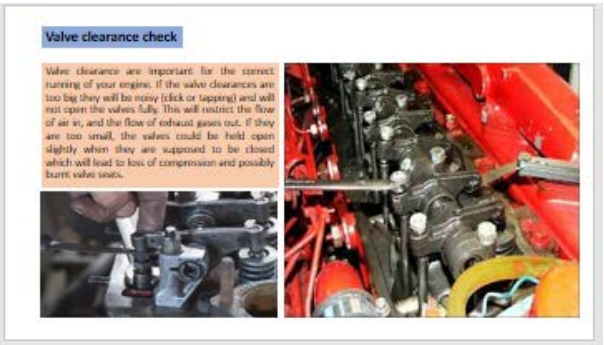
Cleaning batteries: Keep the batteries clean by wiping them with a damp cloth whenever dirt appears excessive. If corrosion is present around the terminals, remove the battery cables and wash the terminals with a solution of baking soda and water. Be careful to prevent the solution from entering the battery cells, and flush the batteries with clean water when finished. After replacing the connections, coat the terminals with a light application of petroleum jelly.

Checking specific gravity: In open-cell lead-acid batteries, use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell. A fully charged battery will have a specific gravity of 1.260. Charge the battery if the specific gravity reading is below 1.215.

Checking electrolyte level: In open-cell lead-acid batteries, verify the level of the electrolyte at least every 200 hr of operation. If low, fill the battery cells to the bottom of the filler neck with distilled water.

32 ★

33 ★



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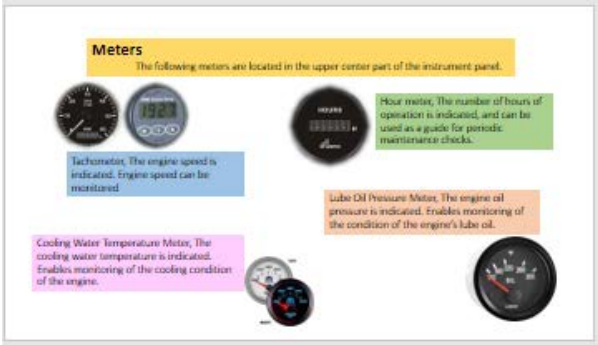

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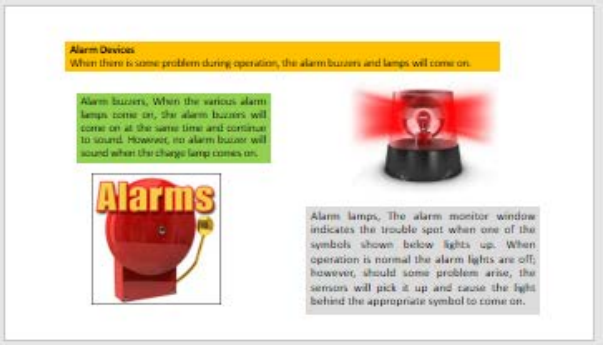

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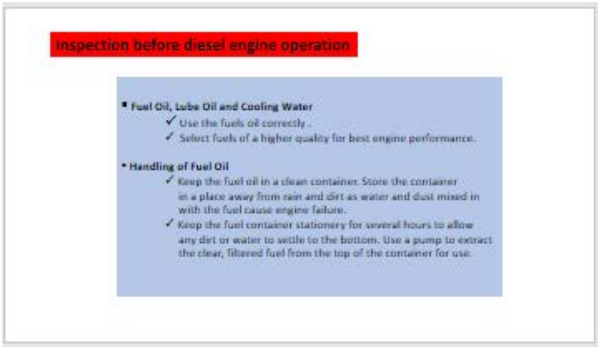

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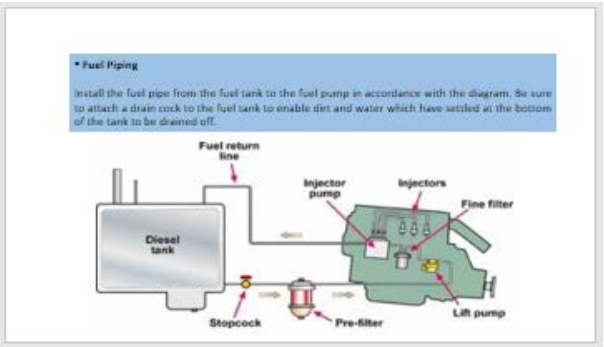

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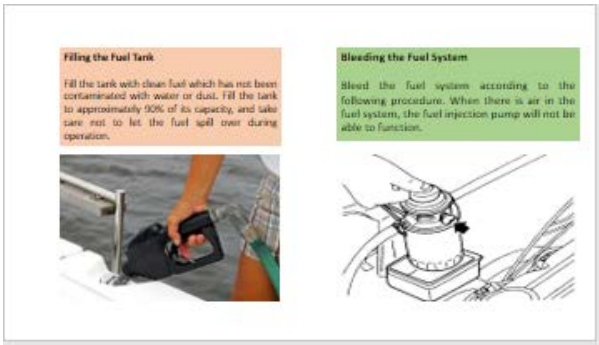

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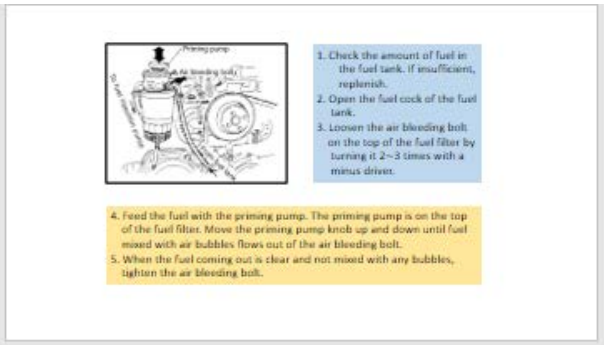


40 ★

Supplying Engine Lube Oil

Fill with the specified amount of engine oil.

1. Remove the oil inlet cap on the top of the bonnet and fill with oil.
2. Remove the oil dipstick and check the level of the oil with the gauge on the stick. Oil should be filled to the upper mark on the dipstick gauge.
3. Replace the dipstick and tighten the oil inlet cap firmly by hand.

41 ★

Supplying Marine Gear Lube Oil

Fill with the specified amount of marine gear oil.

1. Remove the oil inlet cap with dipstick on the top of the marine gear and fill with marine gear oil.
2. Fill with oil to the upper mark on the dipstick attached to the cap. To measure the oil level, wipe the dipstick using a cloth, and then measure the oil level by inserting the dipstick without tightening screw of the oil inlet cap. Fill with the necessary amount of oil.
3. Replace the cap and tighten.

42 ★

Supplying Cooling Water

Burns from Scalding

Never remove the filler cap of the fresh water cooler while the engine is still hot. Wait until the water temperature has dropped, then wrap a cloth around the cap and loosen it slowly. After inspection, refasten the cap firmly.

Tension of the V-Belt

When there is not enough tension in the V-belt, the belt will slip making it impossible for the alternator to generate power. Additionally, the fresh water pump will not work causing the engine to overheat. Check the tension of the V-belt in the following manner.

1. Press the V-belt down with your thumb at the middle of the belt to check the tension. The give in the V-belt should measure about 8~10mm at the depression.
2. To adjust the V-belt tension, loosen the set bolt and move the alternator.
3. Replace the belt if it is damaged.

43 ★

After the Engine has Started

✓ **Warming-up running.** After the engine has started, let it run for about 5 minutes.

✓ **Checking for problems:** While warming up the engine, check the following items.

1. Check that the meters and alarm devices on the instrument panel are normal.
2. Check for water, fuel and oil leakage from the engine and marine gear.
3. Check that exhaust color, engine vibrations and sound are normal.
4. Check that sufficient cooling water is discharged from the seawater outlet pipe.

44 ★

Check During Operation

Always be on the lookout for problems during engine operation. Pay particular attention to the following.

(1) Is sufficient water being discharged from the seawater outlet pipe?
If the discharge is small, stop the engine immediately, identify the cause and repair.

(2) Is the exhaust color normal? The continuous emission of black exhaust shows engine overloading. This shortens the engine's life and should be avoided.

(3) Are there abnormal vibrations or noise? Do not operate at speeds which produce violent vibrations. Depending on the hull structure, engine and hull resonance may suddenly become great at a certain engine speed range, causing heavy vibrations. Avoid operation in this speed range. If you hear any abnormal sounds, stop the engine and inspect.

45 ★

(4) Alarm buzzer sounds during operation.
If the alarm buzzer sounds during operation, lower the engine speed immediately, check the alarm lamps, and stop the engine for repairs.

(5) Is there water, oil, or gas leakage, or are there any loose bolts?
Check the engine room periodically for any problems.

(6) Is there sufficient oil in the fuel tank?
Replenish fuel oil in advance to avoid running out of fuel during operation.

46 ★

List of Periodic Inspections

Item	Content	Daily	Every 6 Month	Every 1 year	Every 2 year	Every 4 year
Fuel oil	Check & supply of oil to the tank	●				
	Drain the fuel tank		●			
	Drain the fuel filter		●			
	Replace the fuel filter element		●	●		

47 ★

Item	Content	Daily	Every 6 Month	Every 1 year	Every 2 year	Every 4 year
Engine Lube oil	Check the quantity of lube oil	●				
	Replace the lube oil		●			
	Replace the lube oil filter element		●			
	Clean the engine oil cooler			●		

48 ★

Item	Content	Daily	Every 6 Month	Every 1 year	Every 2 year	Every 4 year
Marine gear Lube oil	Check the quantity of lube oil	•				
	Replace the lube oil		•			
	Wash the lube oil filter		•			
	Clean the oil cooler			•		

49 ★

Item	Content	Daily	Every 6 Month	Every 1 year	Every 2 year	Every 4 year
Fresh cooling water system	Check & supply of cooling water tank	•				
	Replace the fresh cooling water		•			
	Clean & check the cooling water passage			•		

50 ★

Item	Content	Daily	Every 6 Month	Every 1 year	Every 2 year	Every 4 year
Seawater cooling water system	Check the seawater outlet and discharge	•				
	Check & replace the impeller of seawater pump			•		
	Clean & check the seawater passage			•		
Belt	Adjusting the V-belt tension		•			

51 ★

Item	Content	Daily	Every 6 Month	Every 1 year	Every 2 year	Every 4 year
Piping	Check & replace fuel oil pipe, cooling water pipe	•	•			
Electrical equipment	Check the alarm lamps & devices	•				
	Check & supply electrolyte in battery	•				

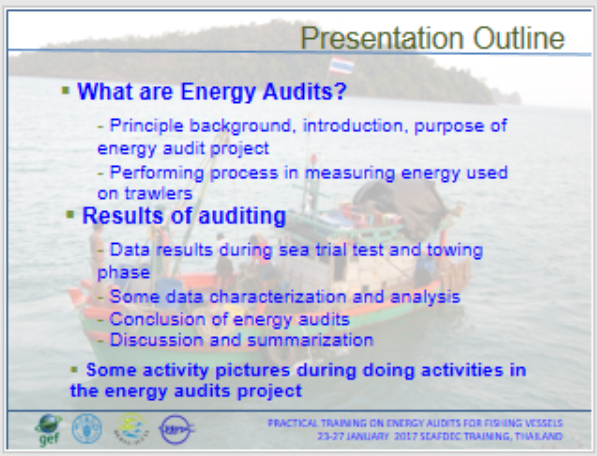
52 ★

Item	Content	Daily	Every 6 Month	Every 1 year	Every 2 year	Every 4 year
Intake and exhaust system	Wash turbocharger blower		•			
	Adjust the intake and exhaust valve clearance			•		
	Lapping the intake and exhaust valve			•		
Fuel injection	Check & adjust the fuel injection pressure & atomizing condition			•		
	Check & adjust the fuel injection timing			•		

53 ★

4. FAO/SEAFDEC Initiative on Fuel Audit on Thai Trawl Fishing Vessel

1



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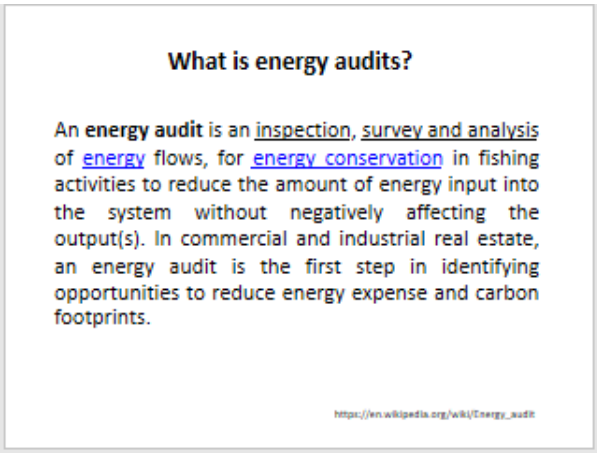

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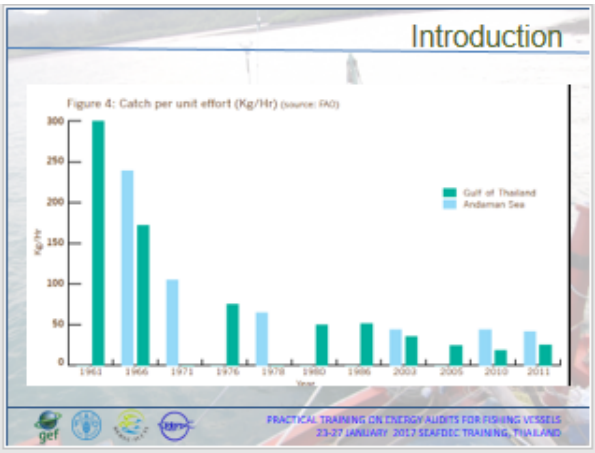

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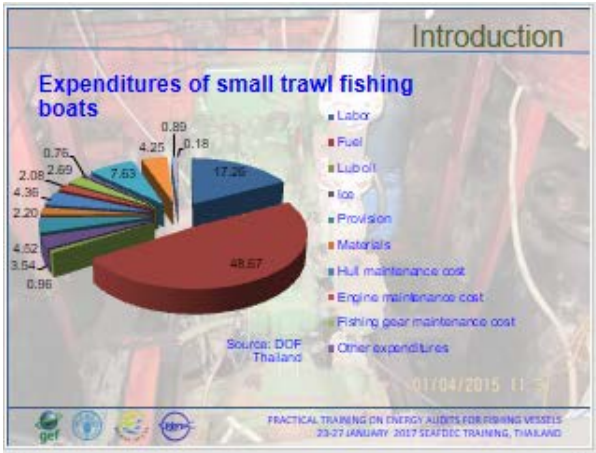

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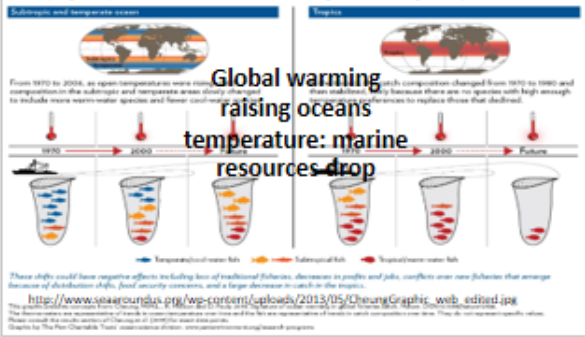
What is background of FAO-SEAFDEC Energy Audits?

Warming Oceans Are Reshaping Fisheries



Global warming raising oceans temperature: marine resources drop

http://www.seaaroundus.org/wp-content/uploads/2013/05/CheungGraphic_web_edited.jpg

7

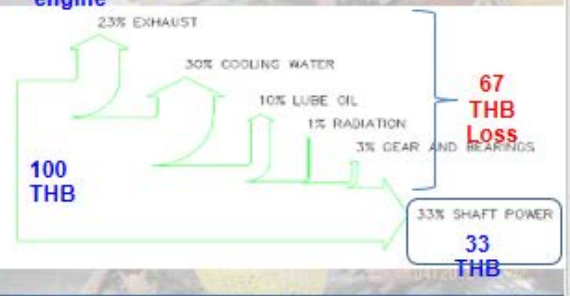
OBJECTIVES OF THE PROJECT

Phase I	Phase II
• To establish energy audits process for Thai trawlers based on Australian method • Extracting parameters influencing fuel consumption profile of trawler and seeking suitable solutions to reduce fuel consumed • Build up awareness of fishermen and owner and techniques on fuel saving to reduce fishing cost	• Continue the first phase of energy audits process and activities to increase more accurate energy measurement system • Expand site of sampling trawl fishing boat in Songkla province to be representatives of trawler in the Southern part along the Gulf of Thailand • Building up awareness on global warming and climate change impacts to fishing activities • Estimate carbon dioxide emission from trawl fishing vessels

8

Principle of energy audit

Efficiency diagram of diesel engine



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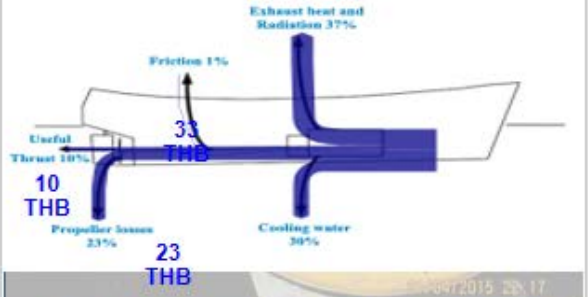
Principle of energy audit



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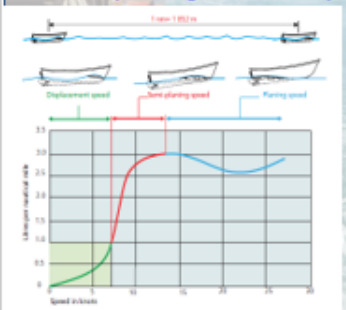
Principle of energy audit

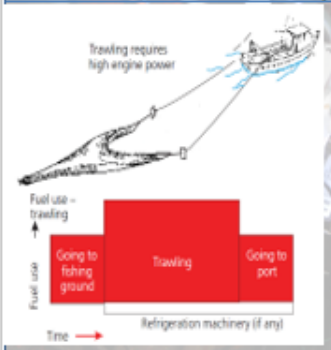
Relationship Among Fuel Consumption per distance and Ship



A figure of fuel consumption per distance (F/d) varied with ship speed consist of three stage of speed as a) displacement speed, b) semi-planing speed, and c) planing speed.
F/d of boat is slightly increase at displacement speed stage, surge at semi-planing speed stage, and constant in planing speed stage.
At sharp curve in semi-planing speed, boat burns a lot fuel to speed up.

11

Principle of energy audit

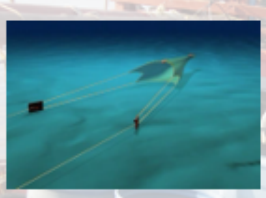


Fuel consumption pattern of small trawl fishing vessels has been classed into two phase: a) steaming to fishing ground and steaming back to fishing port and b) trawling phase. At steaming period, small trawl fishing vessel require less fuel consumption because of fishing ground near coast or fishing port. In contrast with at trawling period, it consumes a lot fuel because of heavy resistance from trawl net and otter board in water . Thus, fuel consumption of small trawl fishing vessel depends on trawling phase.

12

Principle of energy audit

Component drag



- Netting drag = 60 %
- Trawl door drag = 20 %
- Foot dear drag = 10 %
- Trawl warp drag = 5 %
- Trawl bridle drag = 5 %

- Generally, fishing vessel drag is 15-20 % of the gear drag.

Source: www.mi.mun.ca

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Saving fuel for small fishing vessels from FAO manual

- Reject excess weight
- Use optimum vessel speed as possible
- Decrease water resistance on hull and trawl net: remodeling, duct propeller, bigger mesh size of net
- Good engine maintenance
- Do fishing when high marine resource season
- Alternative energy: wind, solar
- Suitable propeller diameter

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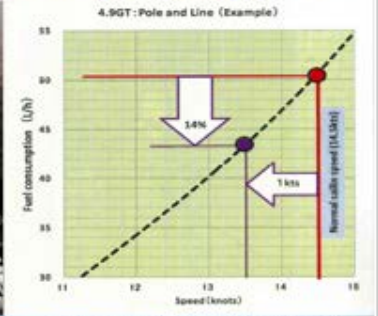
Principle of energy audit

Saving Fuel Consumption of Japanese



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Presentation Outline

- **What are Energy Audits?**
  - Principle background, introduction, purpose of energy audit project
  - Performing process in measuring energy used on trawlers
- **Results of auditing**
  - Data results during sea trial test and towing phase
  - Some data characterization and analysis
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- **Some activity pictures during doing activities in the energy audits project**

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Procedure in auditing energy

Identifying six representatives of small trawl fishing vessels

↓

Installation of measuring devices

↓

Recording fuel flow, time, ship position, ship speed, wind current, wind direction, weight of catches, and income

↓

Extraction of data, calculation, and analysis

↓

Conclusion, disseminating energy audit results

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Energy audits methodologies

- Representative trawl fishing vessels both Gulf of Thailand and Andaman Sea: Chonburi, Satoon , Songkla (<14 m, 14-18 m, >18 m)

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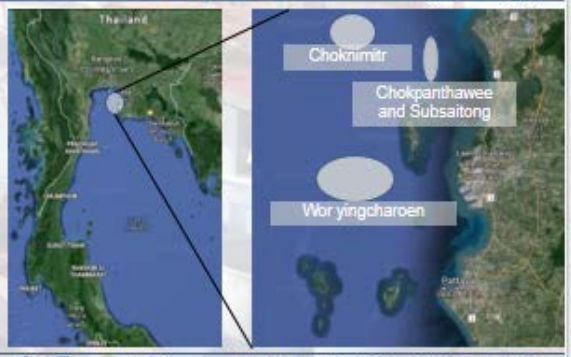
Procedure in auditing energy



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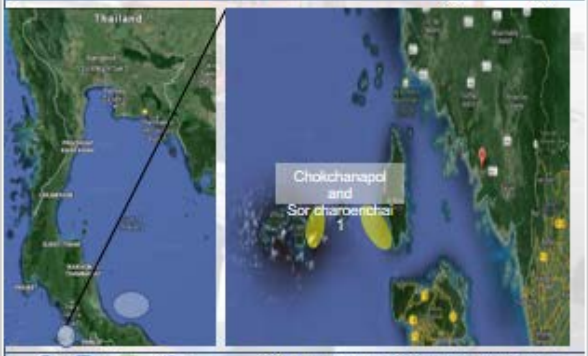
Procedure in auditing energy



20 ★

Procedure in auditing energy
Wor Yingcharoen

Boat Name	W. YingChaRoen
Fishing Gear	Shrimp trawl net
Engine	GARDNER 180Hp
Reduction gear ratio	6:1
Length overall	17m
Length water line	16m
Breadth	4.6m
Draft at mid ship	1.5~1.8m
Fuel oil price	25.52 THB/P
Propeller dia.	50 inch

21 ★

Procedure in auditing energy
Wor Yingcharoen

SPECFICATIONS
- Gardner
- 180 hp
- 5:1 reduction gear ratio
- 1500 – 2500 rpm
- Sea water cooling
- 50" 4 blades propeller

22 ★

Procedure in auditing energy
Chokpanthawee

Boat Name	ChokPanThaWee
Fishing Gear	Shrimp trawl net
Engine	Hino 130 Hp
Reduction gear ratio	4:1
Length overall	11.2m
Length water line	10.4m
Breadth	3.7m
Draft at mid ship	1.38m
Fuel oil price	29.96 THB/l
Propeller dia.	44 inch

23 ★

Procedure in auditing energy
Chokpanthawee

SPECFICATIONS
- HINO
-130 hp
- 6:1 reduction gear ratio
- 1500 – 2500 rpm
- Fresh water cooling
- 44" 4 blades propeller

24 ★

Procedure in auditing energy
Subsaitong

Boat Name	SupSaiTong
Fishing Gear	Shrimp/fish trawl net
Engine	Hino 168 Hp
Reduction gear ratio	4:1
Length overall	11m
Length water line	10m
Breadth	3.7m
Draft at mid ship	1.5m
Fuel oil price	29.96 THB/l
Propeller dia.	38 inch

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25 ★

Procedure in auditing energy
Subsaitong

SPECFICATIONS
- HINO ED100
- 168 hp
- 6:1 reduction gear ratio
- 1500 – 2500 rpm
-Fresh water cooling
- 38" 4 blades propeller

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Procedure in auditing energy
Choknimitr

Boat Name	ChokNiMitr
Fishing Gear	Shrimp/fish trawl net
Engine	Hino 180 Hp
Reduction gear ratio	4:1
Length overall	12m
Length water line	11m
Breadth	3.7m
Draft at mid ship	1.5m
Fuel oil price	29.96 THB/l
Propeller dia.	39 inch

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27 ★

Procedure in auditing energy
Choknimitr

SPECFICATIONS
- HINO ED100
- 180 hp
- 5:1 reduction gear ratio
- 1500 – 2500 rpm
- Sea water cooling
- 39" 4 blades propeller

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Procedure in auditing energy
Sor Charoenchai 1

Boat Name	S. ChaReanChail
Fishing Gear	Shrimp/fish trawl net
Engine	Hino EK 275 Hp
Reduction gear ratio	5:1
Length overall	13.2m
Length water line	12.2m
Breadth	3.1m
Draft at mid ship	1.5m
Fuel oil price	23 THB/l
Propeller dia.	52 inch

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29 ★

Procedure in auditing energy
Sor Charoenchai 1

SPECFICATIONS
- HINO EK 275
- 275 hp
- 5:1 reduction gear ratio
- 600 – 2500 rpm
- Sea water cooling
- 52" 4 blades propeller

PRACTICAL TRAINING ON ENERGY AUDITS FOR FISHING VESSELS
23-27 JANUARY 2017 SEAFDEC TRAINING, THAILAND

30 ★

Procedure in auditing energy
Chokchanapol

Boat Name	ChokChaNaPol
Fishing Gear	Shrimp/fish trawl net
Engine	Hino 190 Hp
Reduction gear ratio	5:1
Length overall	14.0 m
Length water line	13.0 m
Breadth	3.6 m
Draft at mid ship	1.3 m
Fuel oil price	23 THB/l
Propeller dia.	42 inch

31

Procedure in auditing energy
Chokchanapol

SPECFICATIONS
- HINO ED 100
- 180 hp
- 6:1 reduction gear ratio
- 1000 – 2000 rpm
- Sea water cooling
- 42" 4 blades propeller

32

Recording parameters base on Australian method

Sea trial test
- Date
- time
- Value on fuel flow meter (cc, L, m^3)
- Engine revolution (rpm, rps)
- Ship speed (km/h, knot)
- Ship distance (km, nm) 1 nm: 1.852 km

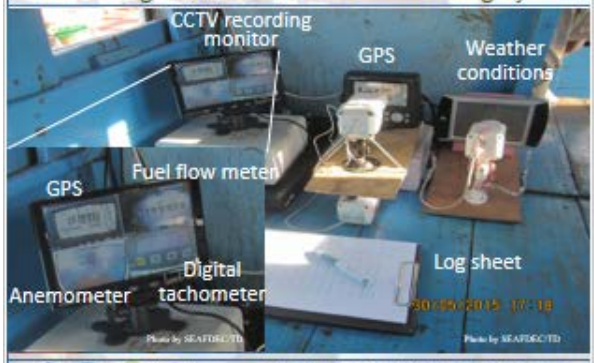
Note: For reliability, calibration check of all auditing equipment is need.

33

Procedure in auditing energy
Installation circuit of fuel flow meter

34

Monitoring devices with CCTV recording system



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Procedure in auditing energy
Measurement of weather

36

Energy audits methodologies

• Base condition of three testing phase:

steaming phase and steaming with net in water phase :
Vary rpm: 600, 700, 800, 900, 1000, 1100, 1200
Date, time, Value on fuel flow meter (cc, L, m^3), Engine revolution (rpm, rps), Ship speed (km/h, knot), Ship distance (km, nm)

towing phase:

37

Energy audits methodologies

• weighting catches (kg)
weighting onboard during sea condition, reading needle value during neutral position, sometime doing activities during having rain

Weighting all catches even solid or litter/rubbishes because they impact to fuel consumption during towing

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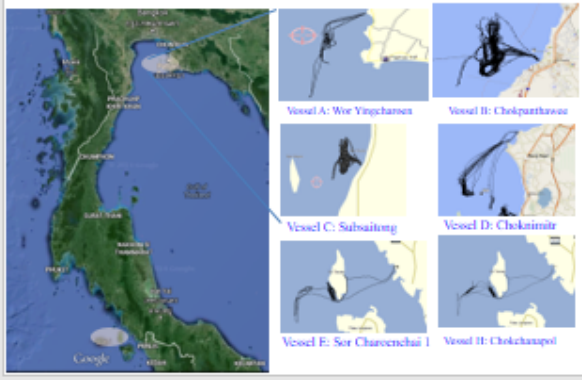
FISHING GROUND LOCATION OF SIX INVESTIGATED TRAWLERS



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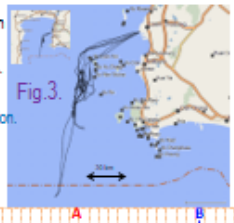
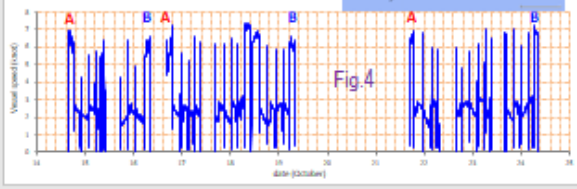
Fuel consumption profile when fishing operation of Vessel A: Wor Yingcharoen

- Fishing operation path during from 14 to 24 is shown in Fig.3.
- Vessel speed during from 14 to 24 is shown in Fig.4.
- We can find this vessel is a multi-day fishing operation.

A: Voyage to the fishing ground
B: Voyage to the port





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Fuel consumption profile when fishing operation of Vessel C: Subsaitong

- Fishing operation path during from 14 to 24 is shown in Fig.5.
- Vessel speed during from 14 to 24 is shown in Fig.6.
- We can find this vessel is a daily return fishing operation. Fishing grounds are very near.

A: Voyage to the fishing ground
B: Voyage to the port

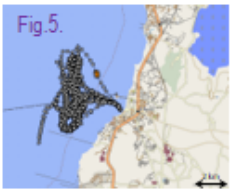
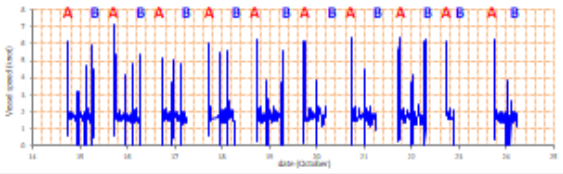


Fig.6



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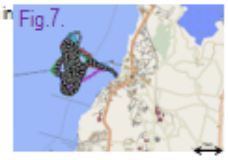
Fuel consumption profile when fishing operation of Vessel B: Chokpanthawee

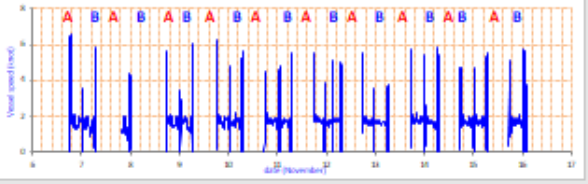
- Fishing operation path during from 6 to 16 is shown in Fig.7.
- Vessel speed during from 6 to 16 is shown in Fig.8.
- We can find this vessel is a daily return fishing operation. Fishing grounds are very near.

Fig.7.



A: Voyage to the fishing ground
B: Voyage to the port

Fig.8



43

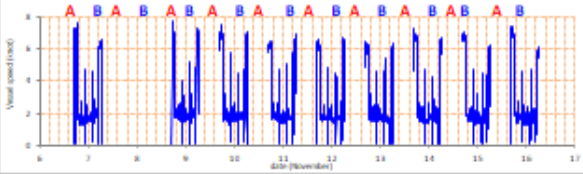
Fuel consumption profile when fishing operation of Vessel D: Choknimitr

- Fishing operation path during from 6 to 16 is shown in Fig.9.
- Vessel speed during from 6 to 16 is shown in Fig.10
- We can find this vessel is a daily return fishing operation. Fishing grounds are very near.

Fig.9.

A: Voyage to the fishing ground
B: Voyage to the port

Fig.10



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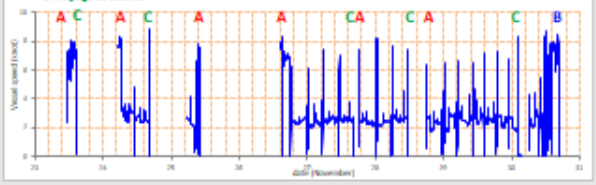
Fuel consumption profile when fishing operation of Vessel E: Sor Charoenchai 1

- Fishing operation path during from 6 to 16 is shown in Fig.11.
- Vessel speed during from 6 to 16 is shown in Fig.12.
- We can find this vessel is a multi-day fishing operation.

Fig.11.

A: Voyage to the fishing ground
B: Voyage to the port
C: Voyage to anchor

Fig.12



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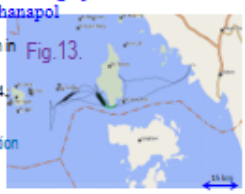
Fuel consumption profile when fishing operation of Vessel F: Chokchanapol

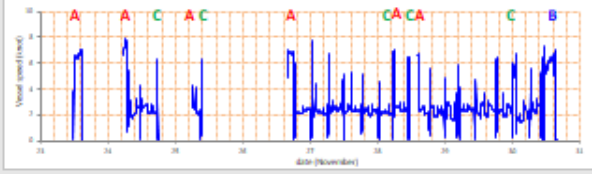
- Fishing operation path during from 6 to 16 is shown in Fig.13.
- Vessel speed during from 6 to 16 is shown in Fig.14.
- We can find this vessel is a multi-day fishing operation

Fig.13.



A: Voyage to the fishing ground
B: Voyage to the port
C: Voyage to anchor

Fig.14



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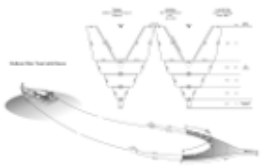
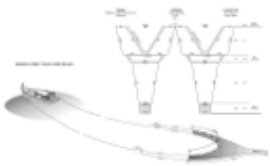
Fishing Net design for trawlers



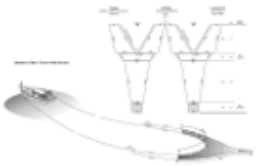
Shrimp trawl net pattern of Vessel A: Wor Yingcharoen



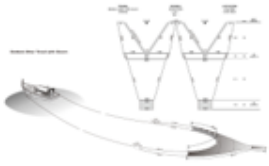
Shrimp trawls net pattern of Vessel B: Chokpanthawee

47

Fishing Gears (Con't)

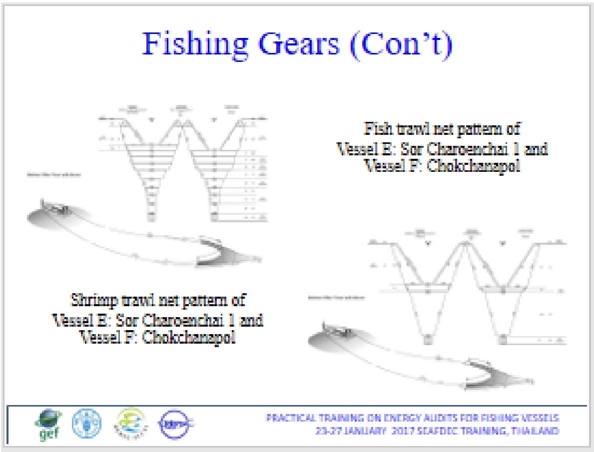


Shrimp trawl net pattern of Vessel C: Subsaitong



Shrimp trawl net pattern of Vessel D: Choknimitr

48



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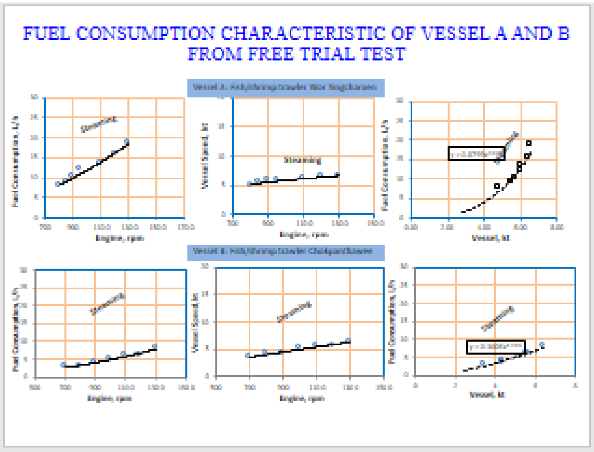

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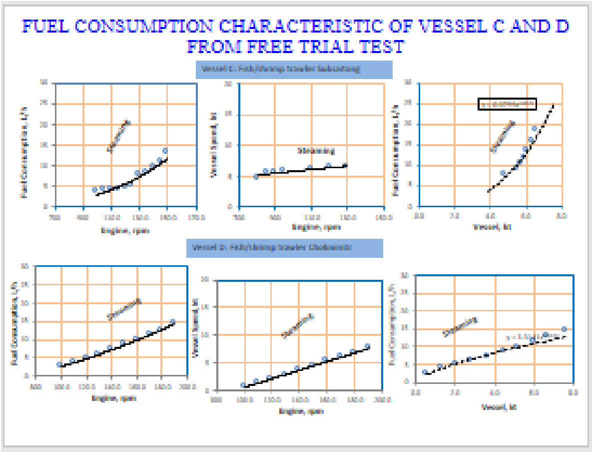

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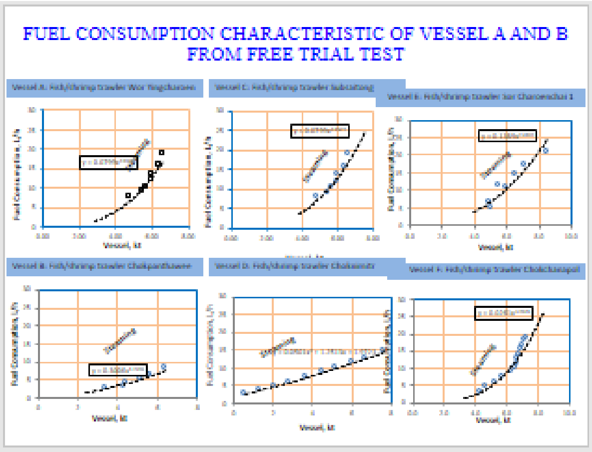

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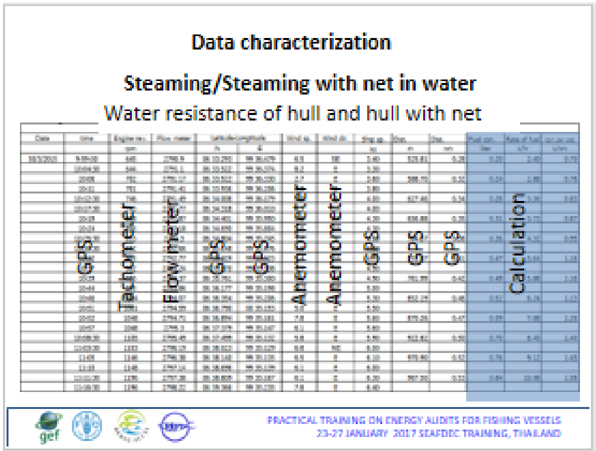

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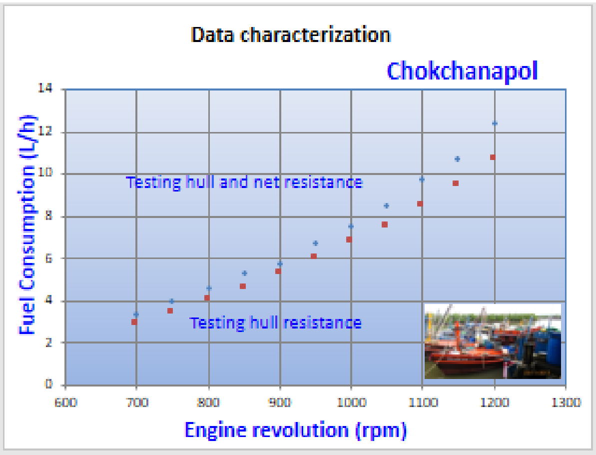

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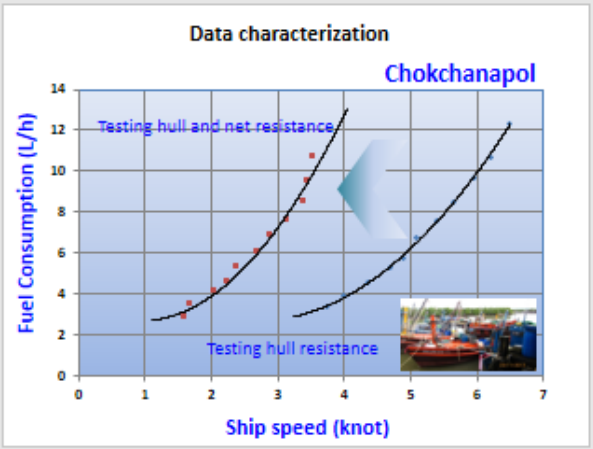

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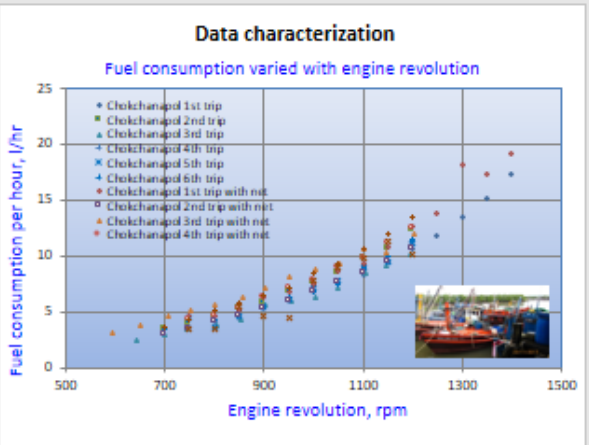

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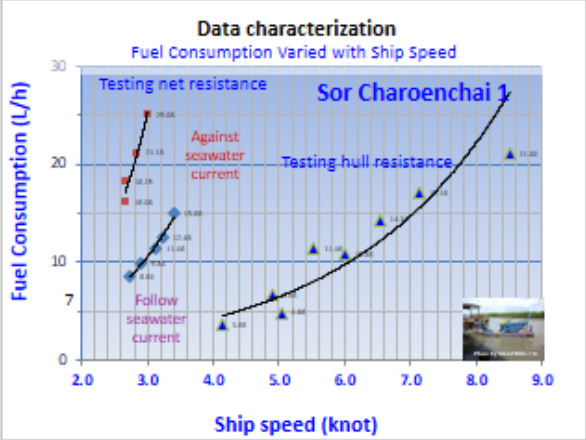

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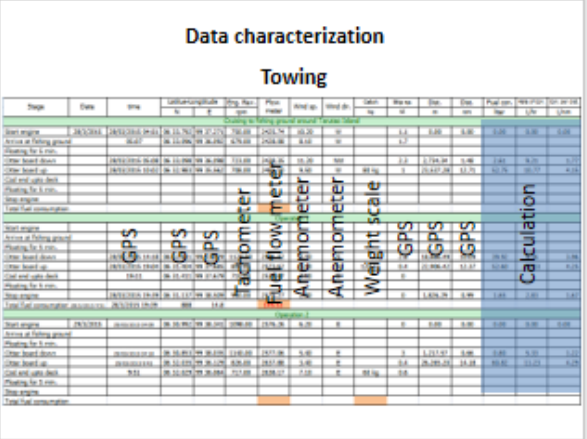

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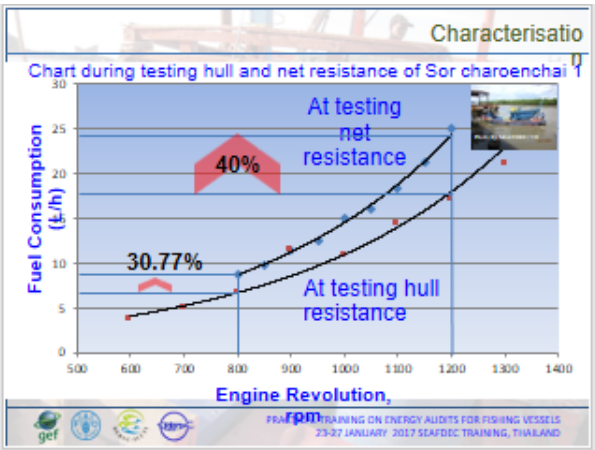

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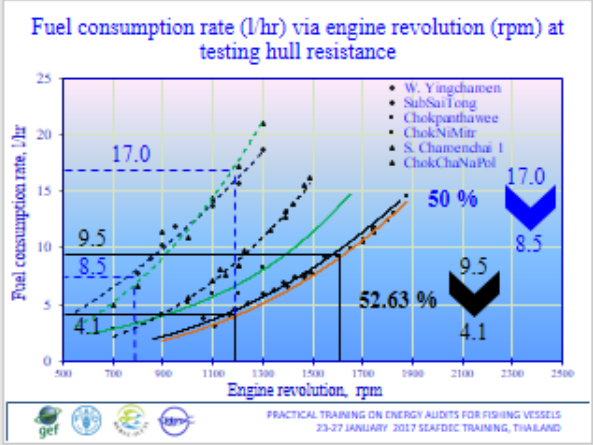

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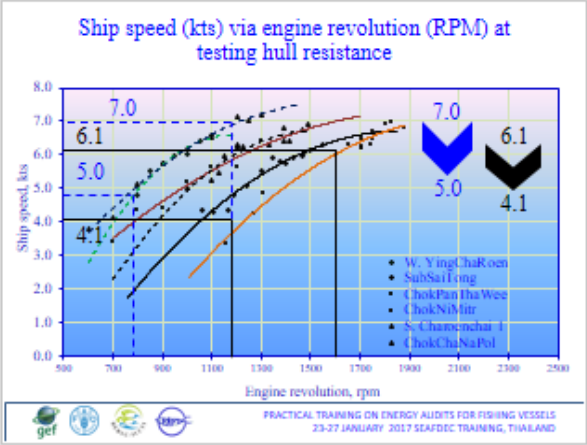

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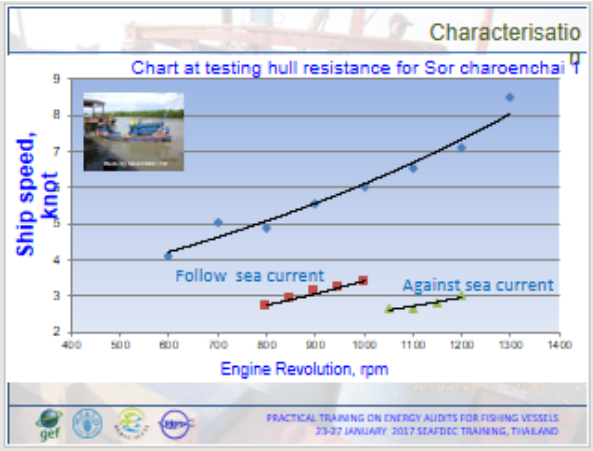

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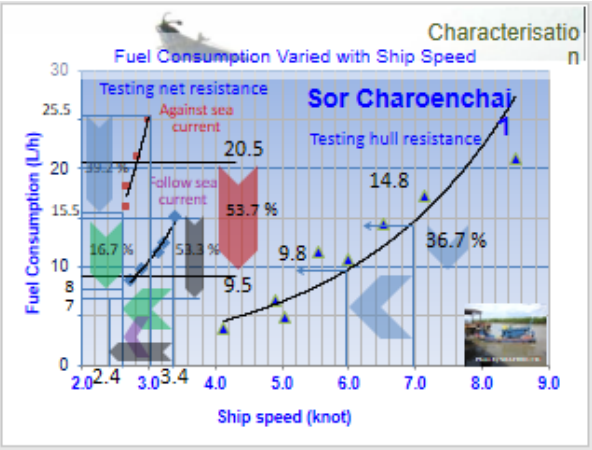

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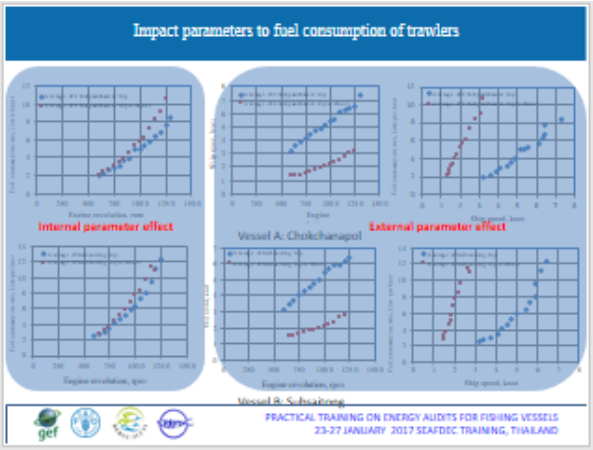

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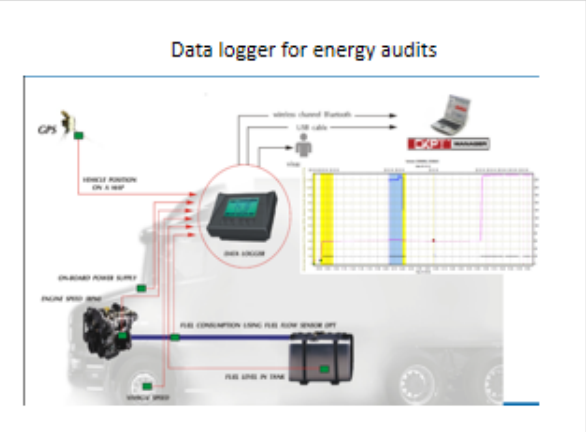

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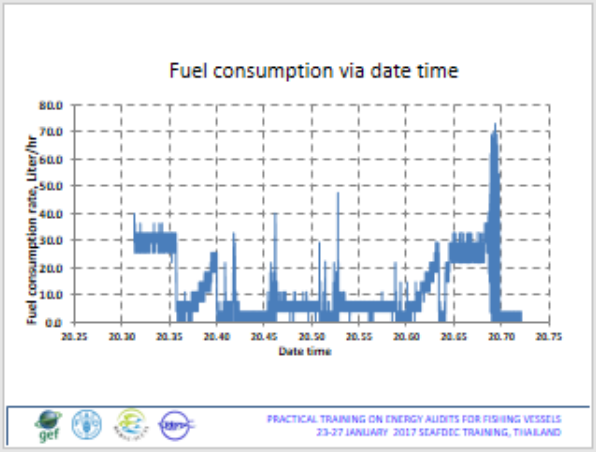

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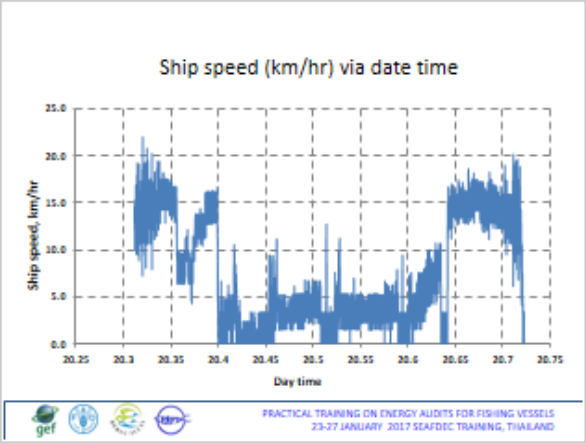

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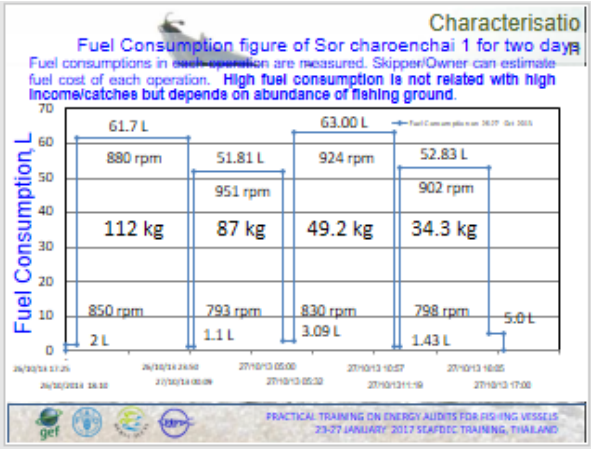

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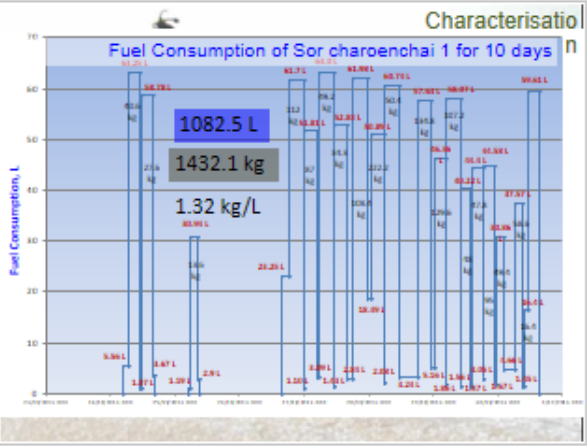

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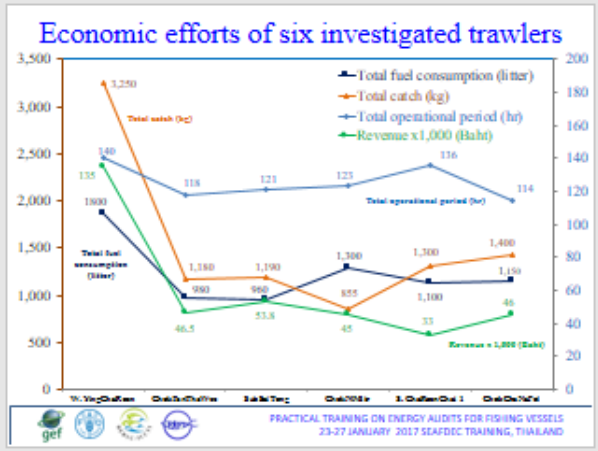

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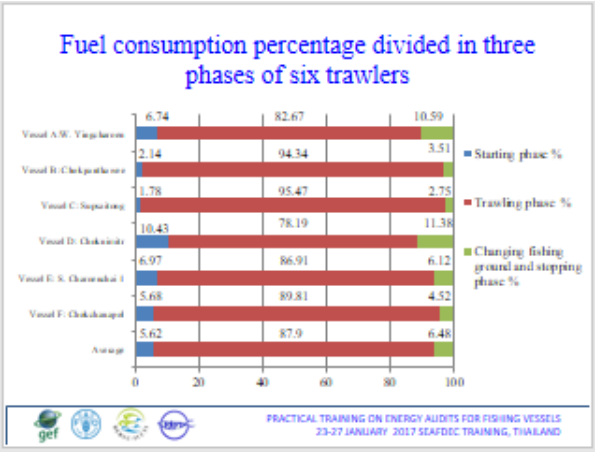

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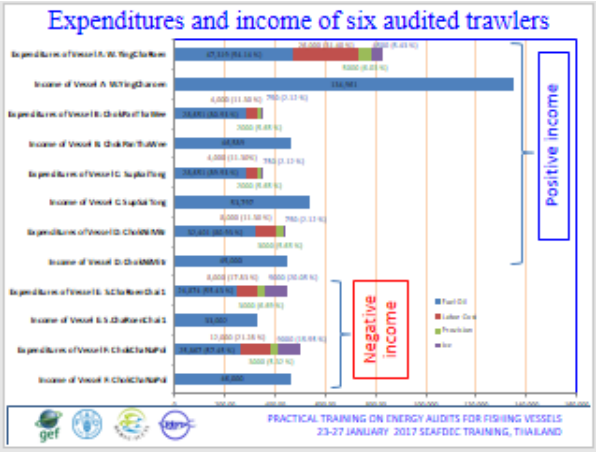


72

FUEL CONSUMPTION PERFORMANCE AND ECONOMIC EFFORTS OF SIX INVESTIGATED TRAWLERS

	Vessel A
Fishing duration (h)	140
Fuel consumption (L)	1,862
Total catch (kg)	3,249
Revenue (THB)	134,961
Fuel used per hour (L/h)	13.3
Catch per hour (kg/h)	23.3
Catch per fuel use (kg/L)	1.7
Revenue per Fuel use (THB/L)	72.5

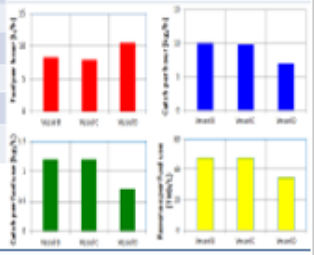
- Vessel A was classed more than 18 m trawler
- 2-3 days fishing operation
- Fuel consumption rate at 13.3 L/h
- Catch rate at 23.3 kg/h
- Revenue per fuel used at 72.5 THB/L

73 ★

FUEL CONSUMPTION PERFORMANCE AND ECONOMIC EFFORTS OF SIX INVESTIGATED TRAWLERS

	Vessel B	Vessel C	Vessel D
Fishing duration (h)	118	121	123
Fuel consumption (L)	978	956	1,288
Total catch (kg)	1,179	1,190	855
Revenue (THB)	46,589	53,797	45,000
Fuel used per hour (L/h)	8.3	7.9	10.5
Catch per hour (kg/h)	10	9.8	7.0
Catch per fuel use (kg/L)	1.2	1.2	0.7
Revenue per Fuel use (THB/L)	47.6	47.7	34.9

- Vessel B, C, and D are classed less than 14 m
- Fuel consumption performance of Vessel D is less than vessel B, and C since larger HP engine.



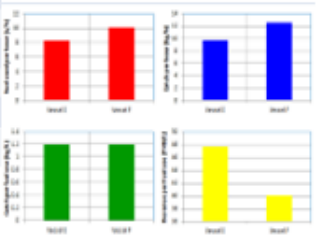
- Similar fuel consumption performance and CPUE of Vessel B, and C
- Low CPUE and revenue of vessel D

74 ★

FUEL CONSUMPTION PERFORMANCE AND ECONOMIC EFFORTS OF SIX INVESTIGATED TRAWLERS

	Vessel E	Vessel F
Fishing duration (h)	136	134
Fuel consumption (L)	1,124	1,149
Total catch (kg)	1,316	1,432
Revenue (THB)	33,000	46,000
Fuel used per hour (L/h)	8.3	10.1
Catch per hour (kg/h)	9.7	12.6
Catch per fuel use (kg/L)	1.2	1.2
Revenue per Fuel use (THB/L)	47.7	40.0

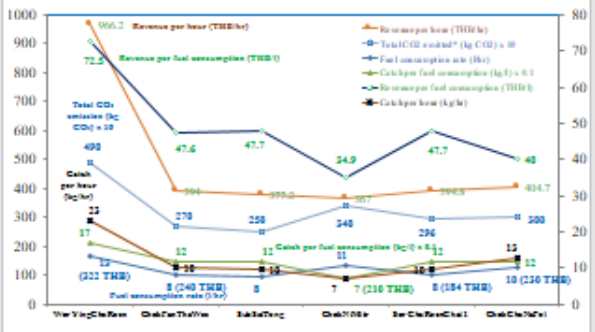
- Vessel E, and F are classed between 14-18 m
- Fuel consumption performance of Vessel F is less than vessel E because small diameter of propeller



- Similar catch per fuel (kg/L) use but dificity of revenue per fuel use (THB/L) because difference catch species
- Better business effectiveness of Vessel F

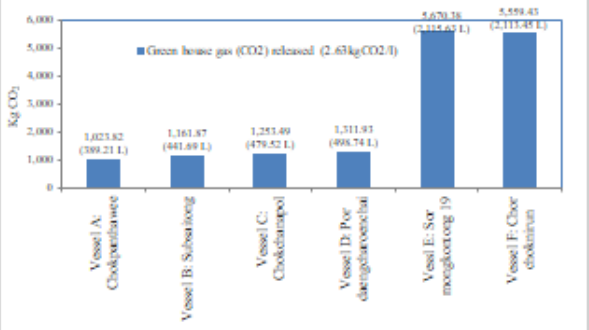
75 ★

Economic efforts of six investigated trawlers



76 ★

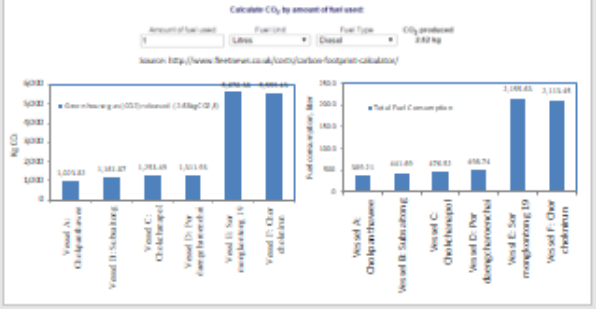
Evaluation on carbon emission from auditing results



77 ★

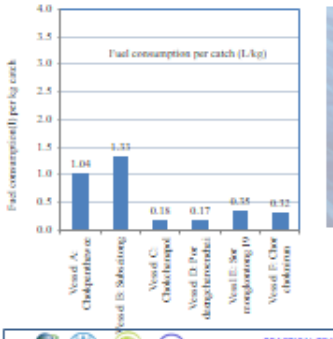
Green house gas emission by trawlers

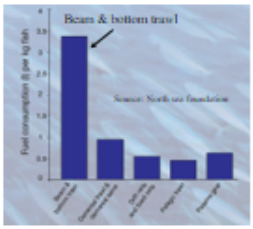
Kilogram CO_2 emission calculated through complete burning of fossil fuel



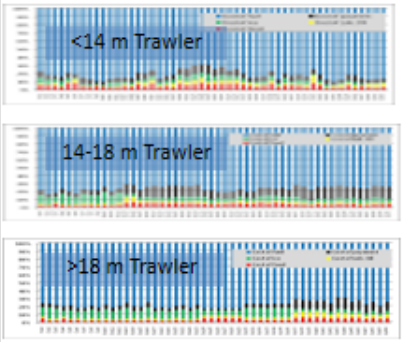
78 ★

Average fuel consumption per kilo catch for difference fishing vessels





BASELINE SURVEY RESULTS FOR THREE CLASSES OF THAI TRAWLER



Baseline survey was done by interviewing each fifty small, medium, and large trawlers along costal of the Gulf of Thailand and Andaman sea, which the results figure out that fuel (80%, 75%, and 75% respectively) is main cost of Thai trawler.

Conclusion

Energy audit project reaches objectives:

- **fuel consumption profile** of each fishing vessel
- **estimation and manipulation** of fuel efficient use
- **carbon credit calculation** via amount of diesel burnt : 2,500 kg CO_2 of Subsaitong, 4,900 kg CO_2 of W. Yingcharoen
- **extract impact parameters** to energy efficient use
- **Several techniques to save fuel consumption** by applying few additional devices or simple operating method.
- **Reducing ship speed** such as 1 knots enable to save total fuel consumption: 37 % of S. Charoenchai 2 during steaming period
- **Almost fuel consumption in towing phase**: 78-90 %
- **Un-matching components of propulsion system**: more consume fuel consumption such as smaller propeller of Choknimitr require high engine rpm to generate trust but high wage loss

Conclusion

- **Carry unnecessary weight**: over loading of compensate ice, a lot basket, water supply
- **Low engine maintenance** and **unsuitable modification** of engine
- **Season of booming marine resources** in each fishing ground
- Economic efforts: **abundance marine resources of fishing ground** like 33,000 THB of S. Charoenchai 1 , 135,000 THB of W. Yingcharoen as the same fishing operation period
- Total catch : **abundance marine resources of fishing ground** : 855 kg of Choknimitr, and 3250 kg of W. Yingcharoen
- Revenue per fuel consumption : **abundance marine resources of fishing ground** such as 34.9 THB/l of Choknimitr, and 72.5 THB/l of W. Yingcharoen

Discussions and Suggestions

- **Variation of engine revolution proportion to fuel consumption rate (L/h)**: high fuel consumption at fast engine revolution and vice versa
- **Sea and weather conditions direct impact to high/low fuel consumption**: lower fuel consumption in strong wind or wave at following wind or current direction
- **Reducing ship speed** 1 knot while testing net resistance, Sor charoenchai 1 is able to drop fuel consumption down to 53.33% at follow sea currrent
- **Cost-efficient handling** when know cost especially fuel consumption of each trawling operation

Discussion and Summarization

Future development for Energy Saving

Operation

- **Vessel speed**: reduce one knot to be able save fuel 30-50 % while trawling for small Thai wooden trawl fishing boat
- **Routes to fishing ground**: short way as possible
- **Timing**: suitable season of fishing ground on boom period of marine resources (at right place right time)
- **Fuel monitoring device**: fuel consumption meter

Fishing gear

- **Fishing gear modification**: Enlarge code end mesh size to 1" (If possible)
- **Clean net**: binnacle growth along surface of net which increase drag resistance exponentially during moving in sea water

Discussion and Summarization

Future development for Energy Saving

Boat Hull

- **Reduce unnecessary load carried**
- **Clean hull surface** often to reduce hull resistance

Propulsion system

- Maintain good conditions:
  - **Cooling system**: Stuck in shell and tube of heat exchanger
  - Periodic **change of Lub Oil**
  - **Cool engine room temperature** with good ventilation: 27-30 °C resulting to low intake air temperature
  - **High reduction gear ratio** such as 6:1, 7:1, or even12:1 (costly)
  - **Wide propeller blade** to increase trust (costly)

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Presentation Outline

- **What are Energy Audits?**
  - Principle background, introduction, purpose of energy audit project
  - Performing process in measuring energy used on trawlers
- **Results of auditing**
  - Data results during sea trial test and towing phase
  - Some data characterization and analysis
  - Conclusion of energy audits
  - Discussion and summarization
- **Some activity pictures during doing activities in the energy audits project**

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Sor charoenchai 1 at Chebilang in

87

Catches unload for selling

88

Wor yingcharoen at Lamchabang in

89

FISH HANDLING TECHNIQUES ON INVESTIGATED TRAWLERS

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PREPARED CATCHES ON DECK OF VESSEL A AND LANDED CATCHES IN BASKETS OF VESSEL E AND F FOR SELLING AT FISHING PORT




Post-survey activities for disseminating results of energy audits in Chonburi

- Understand principle knowledge and results on energy audits must be transferred to local fishermen to increase their awareness on saving fuel resulting to drop their cost through one day seminar.
- Representative officer of DOF Thailand and SEAFDEC training department described benefit of the project to owner and fishermen of local small trawler at Sriracha district in Chonburi.

Post-survey activities for disseminating results of energy audits in Satun

- To transfer energy audit measured on surveyed trawler, project leader explained theory and rationale of the project to contribute to reduce fuel use and GHG released through fishing activities.
- Second seminar was organized in Satun to distribute knowledge of energy audits to local fishers for increasing their income by reducing fuel cost through energy efficiency use.

Acknowledgment

This study is a collaborative project executed by South East Asian Fisheries Development Center (SEAFDEC) and supported by funding from Food and Agriculture Organization of the United Nations, entitled "Energy Audits for an Food Agriculture Organization Fishing Vessel Energy Audit Pilot Project". We would also like to thank the officers of fishing workshop, the skippers and the crews of the six investigated trawlers for their cooperation and support in doing measurement and experiment in the fieldwork.

Thank you
For
Your attention

5. Energy Audit Process

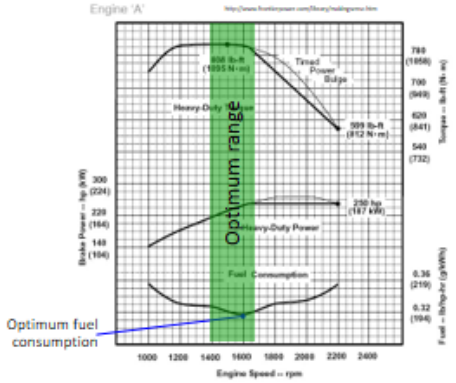
1

Main purpose of measurement

- To extract specific fuel consumption profile of your trawl fishing boat
- Optimizing ship speed for optimum fuel used

2

Characteristic curve of a diesel engine



3

Calibration all measurement equipments

Analog system:

- Setting constant of digital tachometer base on pulse from engine
- Setting interval recording of GPS navigator

Data logger:

- Setting multiplier constant of sensors

4

Energy audits methodologies

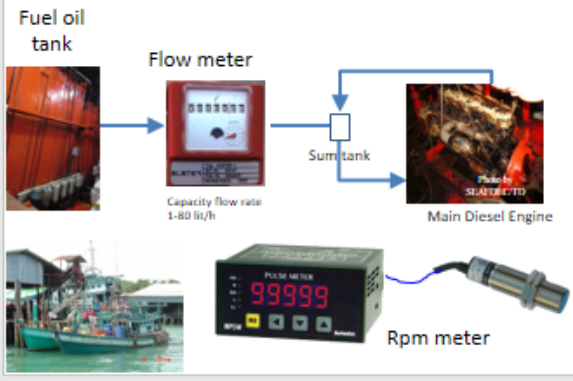
- Base condition of three testing phase:

steaming phase and steaming with net in water phase :
Vary rpm: 600, 700, 800, 900, 1000, 1100, 1200
Date, time, Value on fuel flow meter (cc, L, m^3), Engine revolution (rpm, rps), Ship speed (km/h, knot), Ship distance (km, nm)

towing phase:

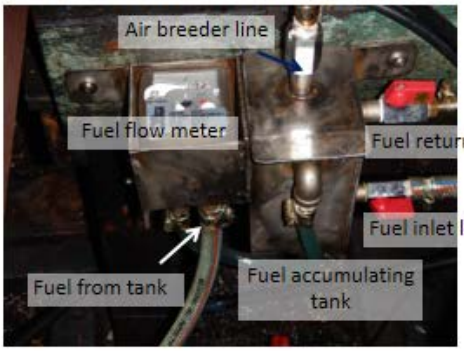
5

Manual indicating devices



6

Fuel flow meter with sum tank



7 ★

GPS navigator

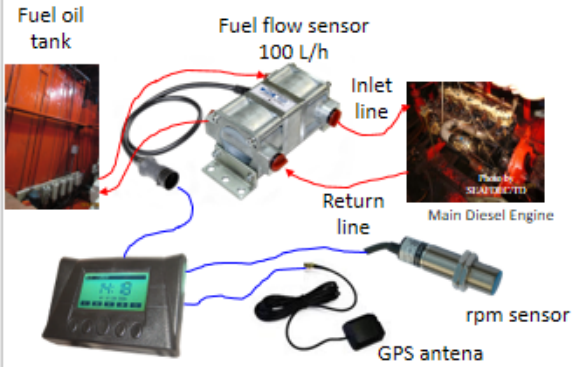
Ship position, Ship speed, ship distance

8 ★

Fuel flow meter with offline camera

9 ★

Energy Audit Data Logger



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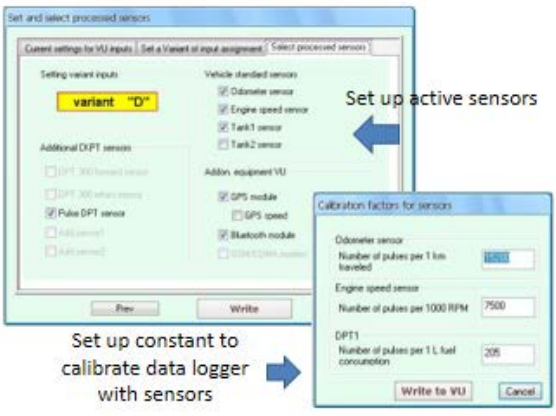

11 ★

Manual Recording data from measurement devices

12 ★

Log sheet

13 ★

Data characterization

Steaming/Steaming with net in water

Water resistance of hull and hull with net

GPS Tachometer GPS Flow meter GPS Anemometer GPS Anemometer GPS GPS Calculation

14 ★

Data characterization

Towing

GPS GPS GPS Tachometer Fuel flow meter Anemometer Anemometer Weight scale GPS GPS GPS Calculation

15 ★

Experimental Results

Engine Revolution (rpm)	Time	Interval (min)	Flow meter (L)	Fuel (L/5 min)	Fuel consumption (L/h)	Speed (knts)
950	15:03:31	5	8363.16	1.24	14.88	3.1
	15:08:31		8364.40			
1000	14:58:33	5	8361.26	1.43	17.16	3.8
	15:01:33		8362.69			
1050	14:48:42	5	8358.51	1.59	19.72	4.2
	14:53:42		8360.47			
1100	14:40:46	5	8356.28	1.72	20.64	5.1
	14:45:46		8358.00			
1150	14:33:10	5	8353.20	2.15	25.15	5.4
	14:38:10		8355.35			
1200	14:23:20	5	8349.48	2.21	26.52	7.0
	14:28:40		8351.69			
1250	14:12:17	5	8346.20	2.70	32.40	8.1
	14:20:17		8347.50			
1300	14:05:51	5	8339.80	3.05	37.08	8.6
	14:10:51		8342.85			

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Calculation example of fuel consumption (L/h)

Engine Revolution (rpm)	Time	Interval (min)	Flow meter (L)	Fuel (L/5 min)	Fuel consumption (L/h)	Speed (knt)
950	15:03:31	5	8363.16	1.24	14.88	3.1
	15:08:31		8364.40			

At 950 rpm

Interval recording time (min.) = 15:08:31 – 15:03:31= 5

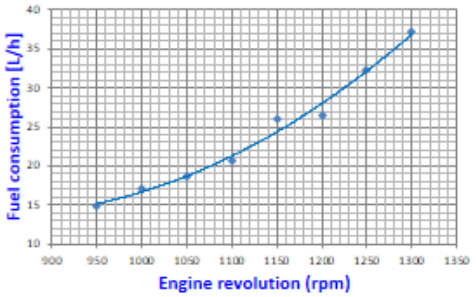
Fuel consumption (L/ 5 min.)= 8364.40-8363.16 = 1.24

Fuel consumption (L/hr) = 1.24 x (60 min./h) / 5 min.

= 14.88

17 ★

Fuel Consumption (L/h) via engine revolution (rpm)



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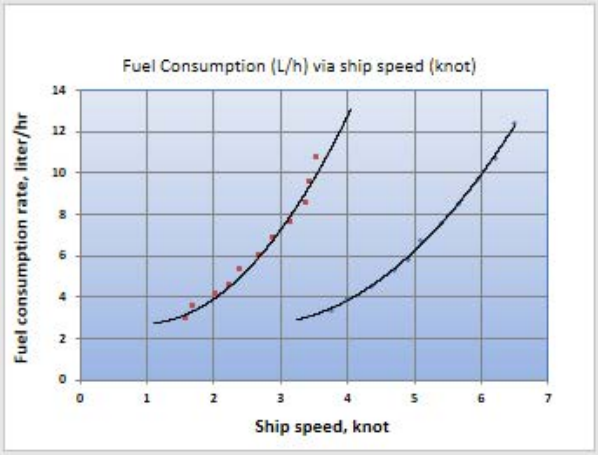

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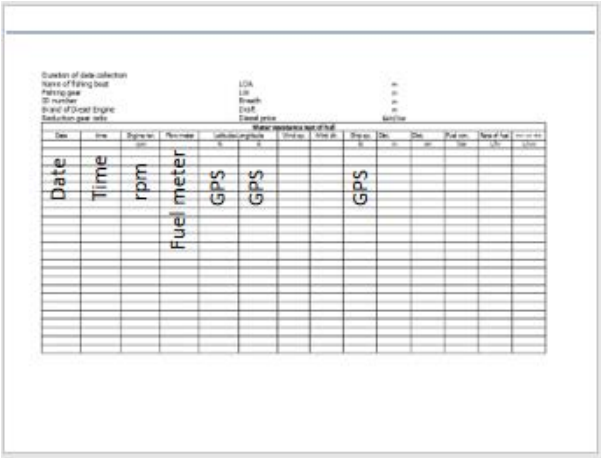

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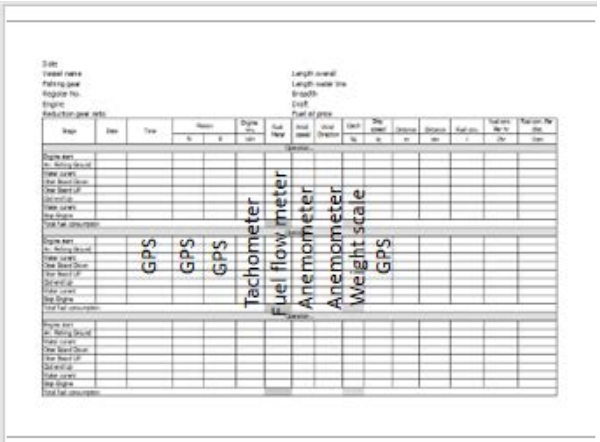

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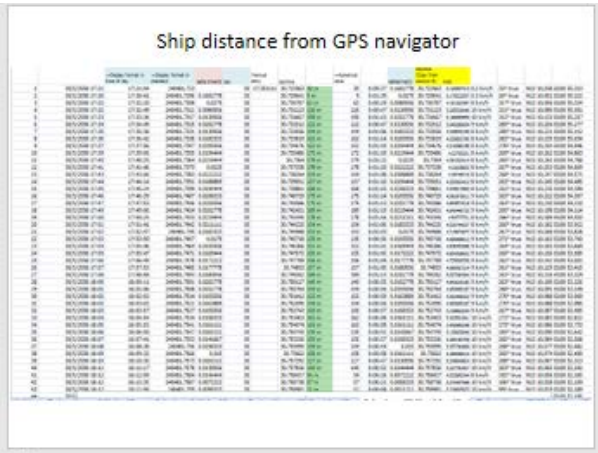

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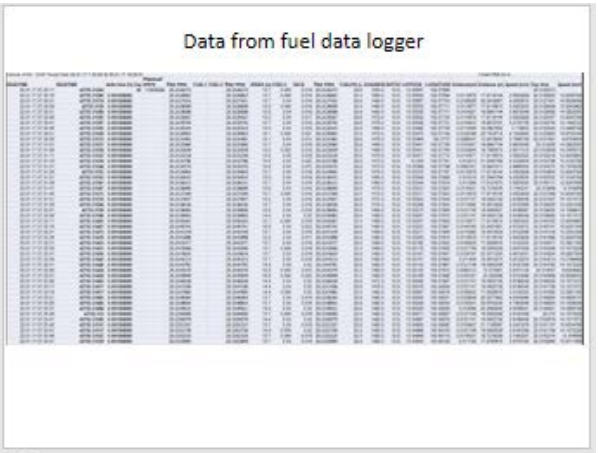

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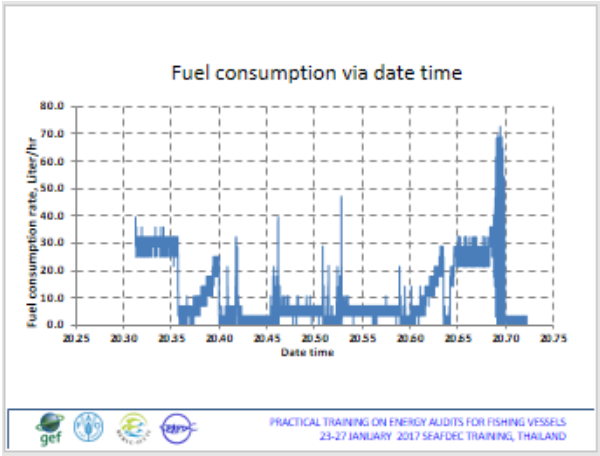
Fuel consumption via date time
Fuel consumption rate, Liter/hr
Date time
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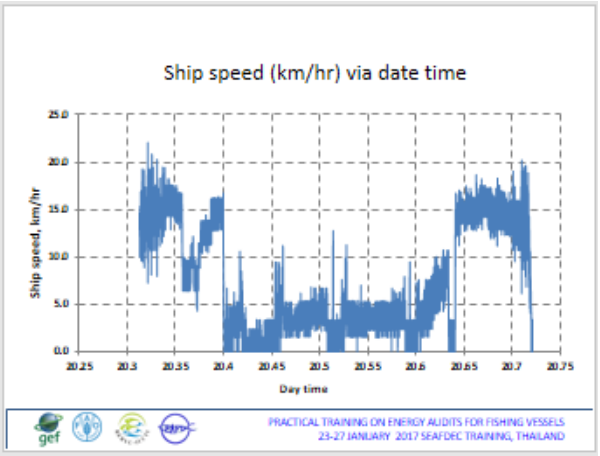
Ship speed (km/hr) via date time
Ship speed, km/hr
Day time
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ขอบคุณครับ
TERIMA KASIH
MERCI
GRAZIE
SALAMAT
GRACIAS
OBRIGADO
THANK YOU
DZIĘKUJĘ
DANKIE
DĚKUJI
DANKE
DANK U
ありがとう
MULȚUMESC
TACK
FALEMNDERIT
PAKKA PÉR

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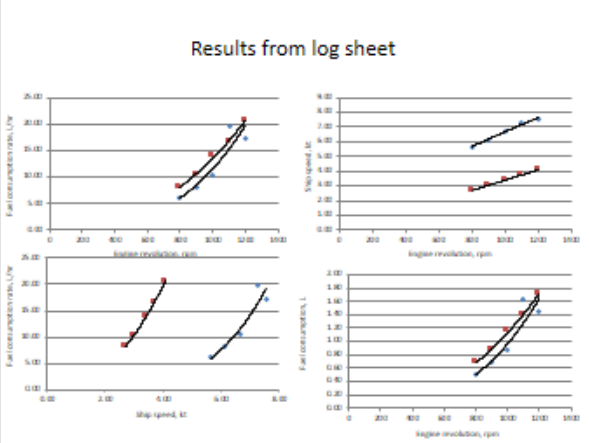
6. Energy Audit Practice

1

2



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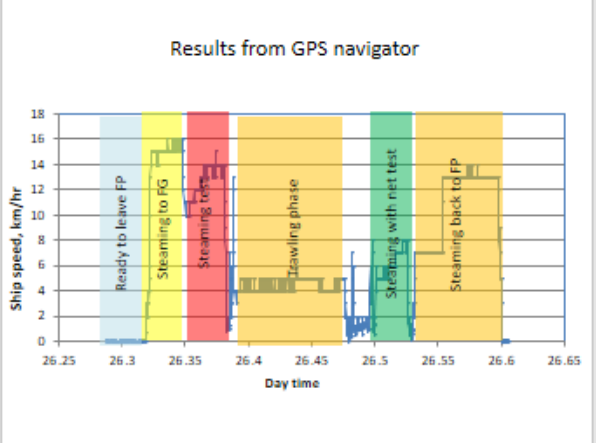

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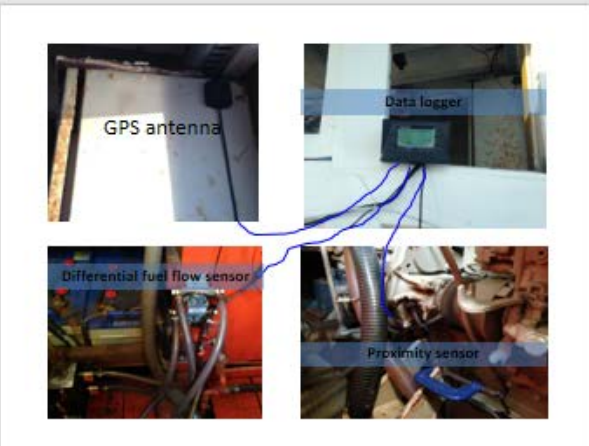

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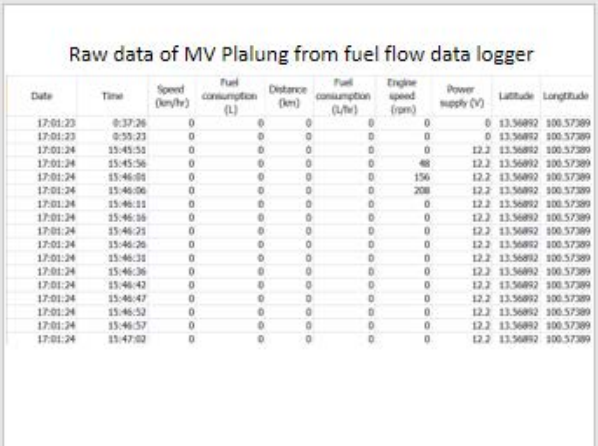


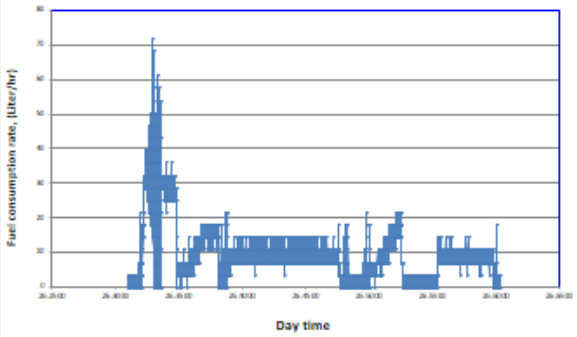
Date	Time	Speed (km/hr)	Fuel consumption (L)	Distance (km)	Fuel consumption (L/hr)	Engine speed (rpm)	Power supply (V)	Latitude	Longitude
17:01:23	0:37:26	0	0	0	0	0	0	13.56892	100.57389
17:01:23	0:55:23	0	0	0	0	0	0	13.56892	100.57389
17:01:24	15:45:51	0	0	0	0	0	12.2	13.56892	100.57389
17:01:24	15:45:56	0	0	0	0	48	12.2	13.56892	100.57389
17:01:24	15:46:01	0	0	0	0	156	12.2	13.56892	100.57389
17:01:24	15:46:06	0	0	0	0	208	12.2	13.56892	100.57389
17:01:24	15:46:11	0	0	0	0	0	12.2	13.56892	100.57389
17:01:24	15:46:16	0	0	0	0	0	12.2	13.56892	100.57389
17:01:24	15:46:21	0	0	0	0	0	12.2	13.56892	100.57389
17:01:24	15:46:26	0	0	0	0	0	12.2	13.56892	100.57389
17:01:24	15:46:31	0	0	0	0	0	12.2	13.56892	100.57389
17:01:24	15:46:36	0	0	0	0	0	12.2	13.56892	100.57389
17:01:24	15:46:42	0	0	0	0	0	12.2	13.56892	100.57389
17:01:24	15:46:47	0	0	0	0	0	12.2	13.56892	100.57389
17:01:24	15:46:52	0	0	0	0	0	12.2	13.56892	100.57389
17:01:24	15:46:57	0	0	0	0	0	12.2	13.56892	100.57389
17:01:24	15:47:02	0	0	0	0	0	12.2	13.56892	100.57389

6

Line track of MV Plalung created from Latitude and Longitude

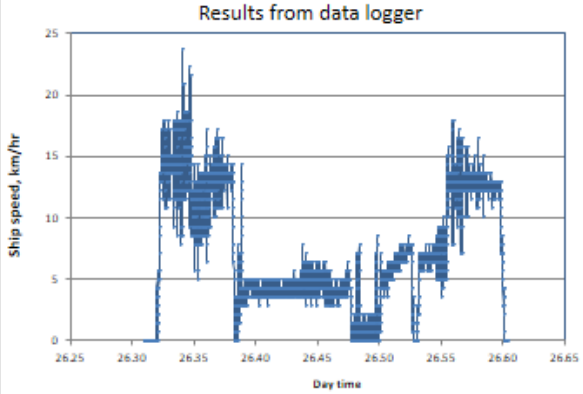
7

Results from data logger



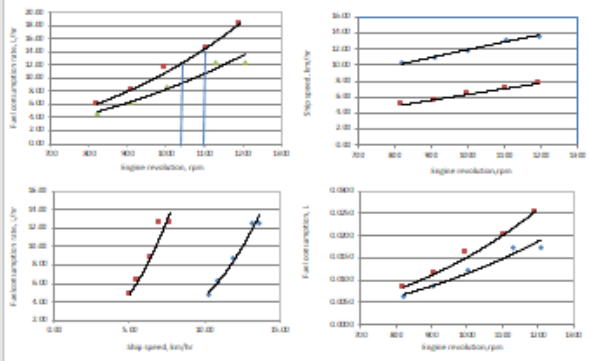
8

Results from data logger



9

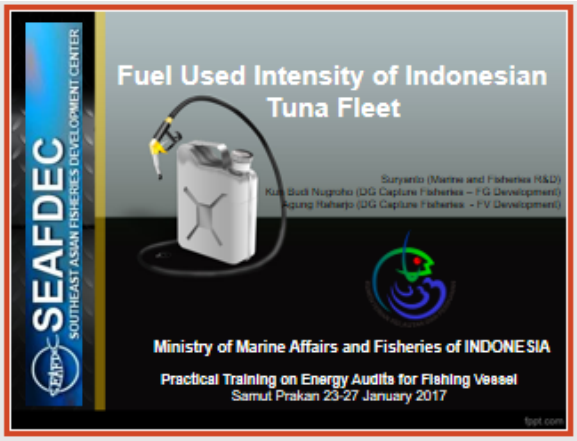
Results from fuel data logger



10

Appendix 9. Presentations of participants

1. Fuel Used Intensity of Indonesia Tuna Fleet



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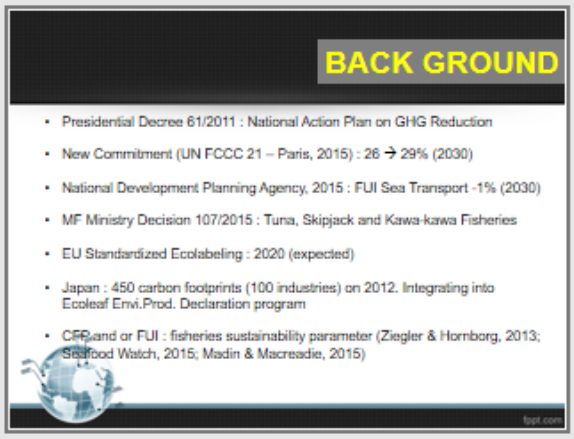

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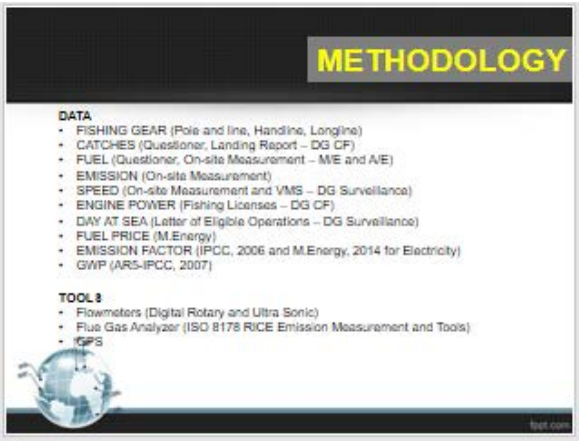

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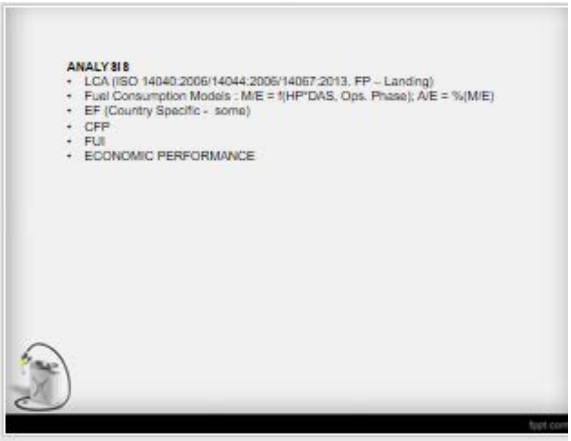

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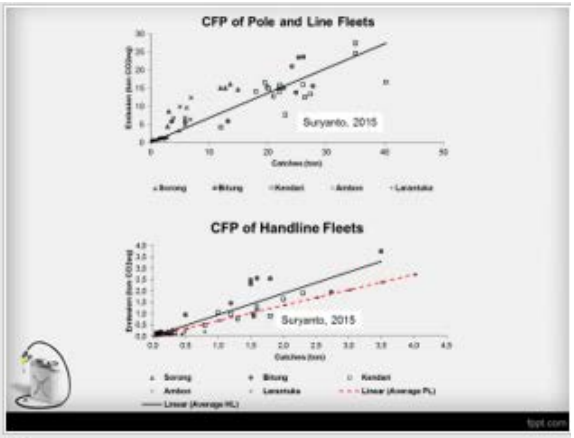
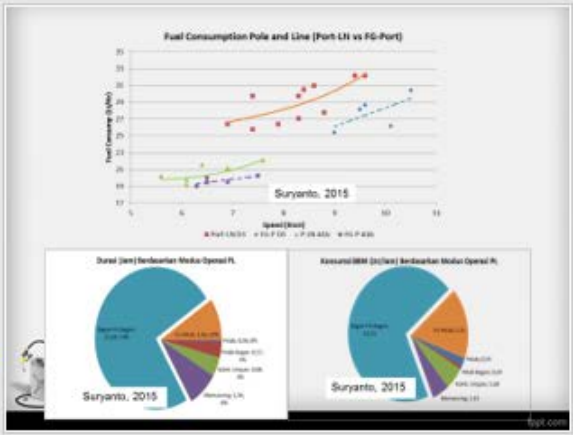
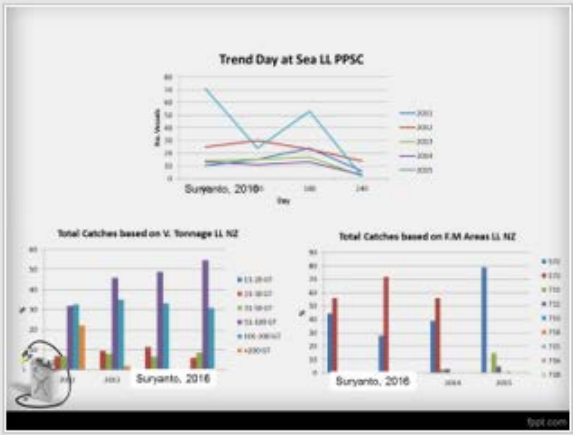


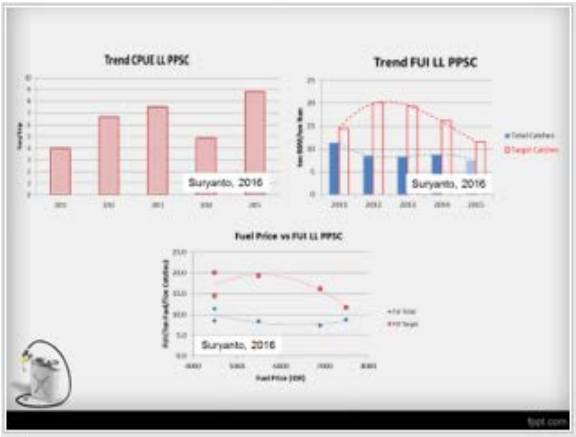
6


Fuel Consumption Pole and Line (Port LH vs FG-Port)
Suryanto, 2015
Suryanto, 2015
Suryanto, 2015

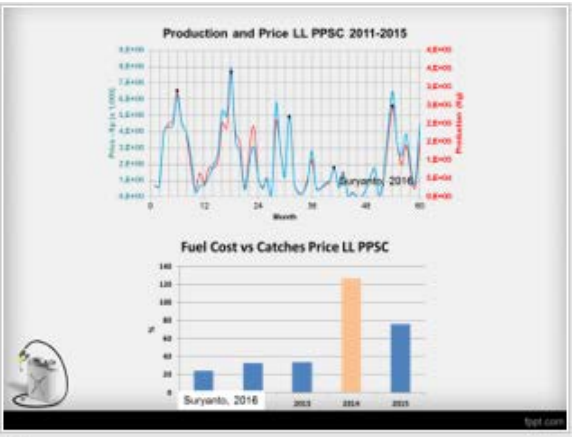
7


Trend Day at Sea LL PPSC
Suryanto, 2016
Total Catches based on V. Tonnage LL NZ
Suryanto, 2016
Total Catches based on F.M Areas LL NZ
Suryanto, 2016

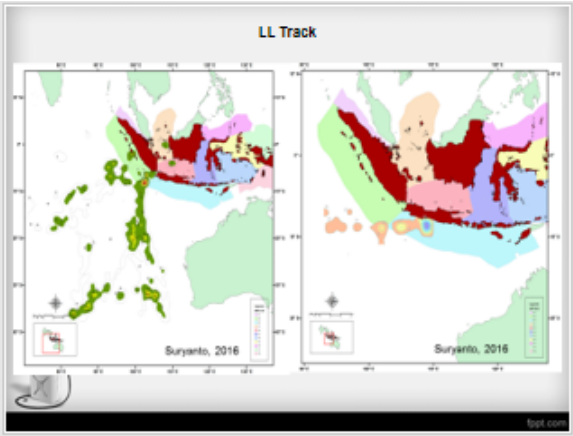
8


Trend CPUE LL PPSC
Suryanto, 2016
Trend FUI LL PPSC
Suryanto, 2016
Fuel Price vs FUI LL PPSC
Suryanto, 2016

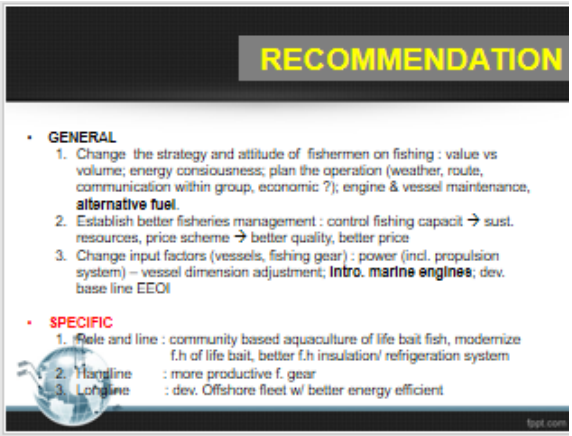
9


Production and Price LL PPSC 2011-2015
Suryanto, 2016
Fuel Cost vs Catches Price LL PPSC
Suryanto, 2016

10


LL Track
Suryanto, 2016
Suryanto, 2016

11


RECOMMENDATION
GENERAL
1. Change the strategy and attitude of fishermen on fishing : value vs volume; energy consiousness; plan the operation (weather, route, communication within group, economic ?); engine & vessel maintenance, alternative fuel.
2. Establish better fisheries management : control fishing capacit → sust. resources, price scheme → better quality, better price
3. Change input factors (vessels, fishing gear) : power (incl. propulsion system) – vessel dimension adjustment; intro. marine engines; dev. base line EEOI
SPECIFIC
1. Pole and line : community based aquaculture of life bait fish, modernize f.h of life bait, better f.h insulation/ refrigeration system
2. Trawl line : more productive f. gear
3. Longline : dev. Offshore fleet w/ better energy efficient

12

2. Report on Fuel Tank Capacity of Fishing Vessel of Malaysia

REPORT ON FUEL TANK CAPACITY OF FISHING VESSELS

ENGINEERING DIVISION
DEPARTMENT OF FISHERIES MALAYSIA

1

PURPOSE

i) Reporting the capacity limit.

ii)Method to control and prevent subsidy leakages.

iii)Method to save fuel capacity per operation.

2

SCOPE OF THE RESEARCH

i) Doing ground survey.
ii) Technical studies relating to maximum horsepower engine and vessel tonnage.

3

REPORT ON FUEL TANK CAPACITY OF FISHING VESSELS

Vesel Zon B	Vesel Zon C	Vesel Zon C2
> 5 nautical miles	> 12 nautical miles	> 30 nautical miles

4

REPORT ON FUEL TANK CAPACITY OF FISHING VESSELS

Popular Engine Vessels

Cummins
Model & Horsepower
- NTA 855-D(M), 385 HP
- KT-19, 420 HP

HINO
Model & Horsepower
- EF 550, 300 HP
- EH 500, 150 HP

MITSUBISHI
Model & Horsepower
- 6D 22, 166 HP
- 6D 22T, 214 HP

5

Horsepower Limit in Licencing Policies

Vessel Type	Tonnage (GRT)	Max Limit (Hp)
Tradisional Gear	< 25	200
(Drift nets)	25 until < 40	300
Commercial Gear	< 20	200
(Trawler, Purse Seiner)	20 until 39.9	300
	40 until 69.9	500
	70 over	No limit
MPPI	< 40	< 250
Kenka 2 Bot	< 10	< 200
SKL Kerang/Siput Sudu	< 20	< 200
SKL Sangkar Ikan	< 40	< 200
Angkut Ikan (C3)	No limit	No limit
Siput Retak Seribu	10 over	200

6

REPORT ON FUEL TANK CAPACITY OF FISHING VESSELS

- The maximum size tank capacity allowable is depend on type of vessel, tonnage vessel, maximum horsepower engine, catch fishing zone and number of days the vessel operate in sea.

7

REPORT ON FUEL TANK CAPACITY OF FISHING VESSELS

- Studies on the maximum engine horsepower

Vessel Types	Tonnage, GRT	Horsepower Limit	Diesel Tank Capacity Limit (Liter)
Tradisional Gear	< 25 25 dan < 40	200 300	4,000 6,000
Commercial Gear	< 20 20 - 39.9 40 - 69.9 > 70	200 300 500 No limit	3,000 6,000 10,000 14,000

8

REPORT ON FUEL TANK CAPACITY OF FISHING VESSELS

- Studies on vessel tonnage, GRT

Tonnage GRT	Diesel Tank Capacity Limit (Liter)
0.1 - 10 10.1 -20 20.1 - 30 30.1 - 39.9	1,000 3,000 5,000 6,000
40 - 49.9 50 - 59.9 60- 69.9	8,000 9,000 10,000
70 - 99.9	14,000

9

REPORT ON FUEL TANK CAPACITY OF FISHING VESSELS

- Estimation Rate, 1 GRT = 140 Liter

Capacity, GRT	Diesel Tank Capacity Limit (Liter)
10 20 30 40 50	1,400 2,800 4,200 5,600 7,000
60 70 80 90	8,400 9,800 11,200 12,600
100 200 300	14,000 28,000 42,000

10

LAPORAN KAJIAN HAD KAPASITI TANGKI MINYAK VESEL PENANGKAPAN IKAN DI MALAYSIA

- Studies on the maximum engine horsepower petrol

Vessel Type	Length (m)	Horsepower Limit	Petrol Tank Capacity Limit (Liter)
Sampan Semenanjung Dan Labuan	Not more 11 m	0 - 60 61 - 120	50 100
Sampan Sarawak	Not more 15 m	0 - 60 61 - 120 121 - 140	50 100 200

11

THANK YOU

12

3. Fisheries in Myanmar and Present Condition of Energy Saving Program for Fishing Vessel

MINISTRY OF AGRICULTURE, LIVESTOCK AND IRRIGATION

DEPARTMENT OF FISHERIES

Fisheries in Myanmar and Present condition of energy saving program for Fishing vessel.

Kyaw Swar Win
Bhone Myint Aung
Department of Fisheries
Myanmar

1

2

Myanmar Fisheries

(I) Inland fisheries
1. Leasable fisheries
2. Open fisheries
3. Tender fisheries

(II) Marine Fisheries
1. Inshore fisheries
2. Offshore fisheries

(III) Aquaculture

3

I. Inland Fisheries

1. leasable fishery.
- Fishing by Grant (demarcated area)
- Fisheries water (temporary / permanent)
- Yearly / long term through auction
- Fishing rights are granted under a lease
- Three year granted Fishery



4

I. Inland Fisheries

2. Open fishery
- Fishing by license (open waters)
- With - allowable fishing gears
- Fixed and floating/moving fishing implements






5

I. Inland Fisheries

3. Tender fisheries
- Fishing rights are permitted by issue of fishing implement licence or by floating tenders after specifying the fishing grounds.


6

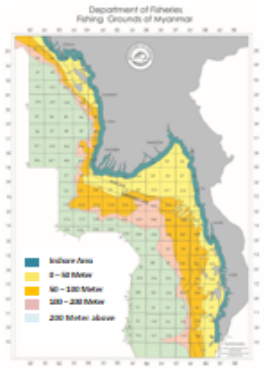
Marine fisheries

1. Inshore or Coastal fishery

- 10 nautical mile from shore
- DOF don't allow more than 25 H.P engine & 30 Feet length of the boat.


2. Off shore fishery

- Outer area of inshore to end of EEZ
- More than 25 H.P engine boat
- Bottom trawl, Purse seine, Surrounding net, Drift net & Long line.

7 ★

Number Fishing vessels

No.	Year	Small Fishing Boat		Off-shore Vessels		Total
		Powered Boat	Non-Powered Boat	National	Foreign	
1	2003-2004	13664	16335	2121	27	32147
2	2004-2005	14176	16687	2150	451	33464
3	2005-2006	14099	16361	2022	254	32736
4	2006-2007	14284	16284	1871	206	32645
5	2007-2008	14289	15219	1863	248	31619
6	2008-2009	14025	14645	1758	356	30784
7	2009-2010	13788	17054	1814	391	33047
8	2010-2011	13823	15548	2047	396	29767
9	2011-2012	12288	15463	2598	245	30594
10	2012-2013	12157	12757	2724	139	27777
11	2013-2014	12490	13732	2736	153	29111
12	2014-2015(Prov.)	12240	13391	2718	52	28401

8 ★

9 ★

Optimizing Energy

Existing Fishing Vessels

- Slow down the cruising speed
- Remove unnecessary things/weight on vessels
- Cleaning of hull-surface, rudder, and propeller
- Regular maintenance of the main engine
- Attaching new appendage (s)
  - Modify the engine
  - Propeller design


10 ★

Optimizing Energy

New Fishing Vessels

- Body shape
- Appendages (keels, etc.)
- Propeller
- Engine



11 ★

Current Practice in Myanmar

Trawler

- ½ Fuel amount at departure – refilling at sea by the carrier
- Enlargement the diameter of propeller
- Modification of engine

Purse seiner

- Enlargement the diameter of propeller


12 ★

Innovation of Private Sector –Trawler

Items	Cost of modification
Fly wheel, gears, propeller	100,000 USD

Items	After
Saving of fuel consumption	300 liter/day
Number of days at sea	90 days
Total fuel saving	27,000 litters
Cost of saving per trip (90 days)	27,000 USD

Engine 500 hp

Investment cost will be returned within 1 ~ 2 y

13 ★

Follow-up Activities need to;

- Pilot study
  - fuel consumption – trawlers, purse seiners, etc.
- Record of fishing vessels in Myanmar (additional)

14 ★

15 ★

4. Energy Use of Bottom Trawl Fisheries in Thailand

Energy Use of Bottom Trawl Fisheries in Thailand

Watcharapong CHUMCHUEN
Narupon DARUMAS
Phitsanu ROEKWIREE

Fishing Technology Development Unit
Department of Fisheries, Thailand

1

Outline

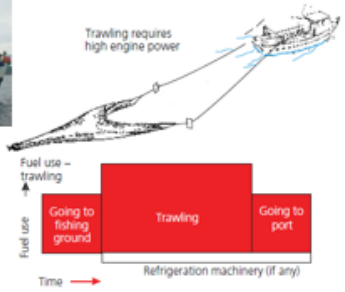
1. Fuel use in bottom trawl fisheries
2. Bottom trawl fisheries in Thailand
3. Fuel consumption of Thai trawlers

2

1. Fuel use in bottom trawl fisheries

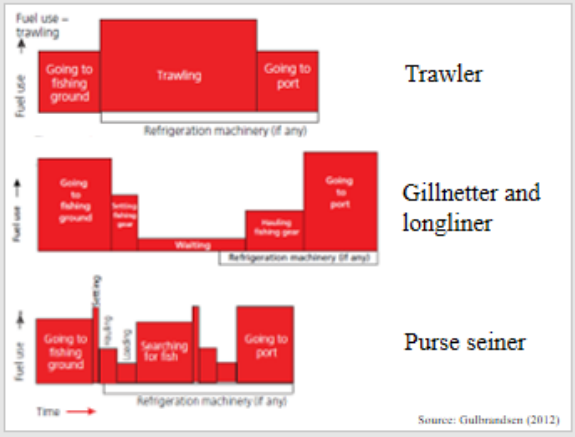
3

Fuel use in bottom trawl fisheries



Source: Gulbrandsen (2012)

4



5

2. Bottom trawl fishery in Thailand

6

Bottom trawl fisheries in Thailand

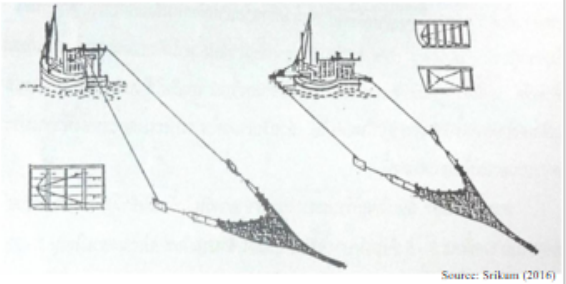
There are 3 main types of bottom trawls

- Otter board trawl
- Beam trawl
- Pair trawl

7

Otter board trawl

Using 2 otter boards to spread the trawl net



Source: Srikum (2016)

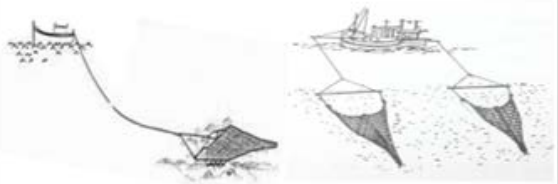
8

Source: Srikum (2016)

9

Beam trawl

Using a beam to spread the trawl net



Source: SEAFDEC (1986); Srikum (2016)

10

Source: Srikum (2016)

11

Pair trawl

Using 2 boats to spread the trawl net

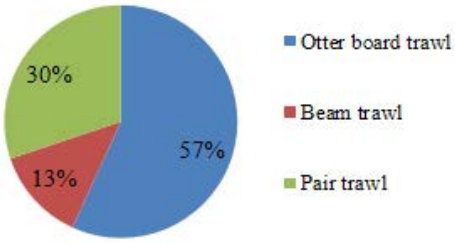
Source: SEAFDEC (1986)

12

Source: Srikum (2016)

13

Among the 3 types, otter board trawl is the most widely operated in Thailand.



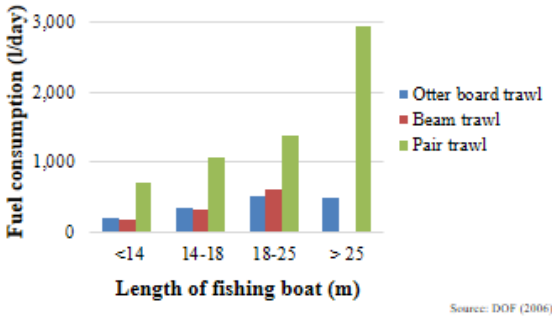
Source: DOF (2016)

14

3. Fuel consumption of Thai trawlers

15

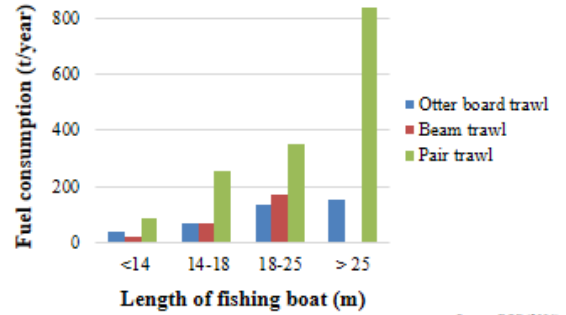
Fuel consumption per fishing day of Thai trawlers



Source: DOF (2006)

16

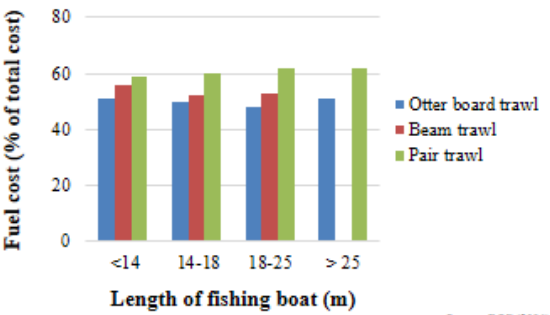
Fuel consumption per year of Thai trawlers



Source: DOF (2006)

17

% fuel cost



Source: DOF (2006)

18

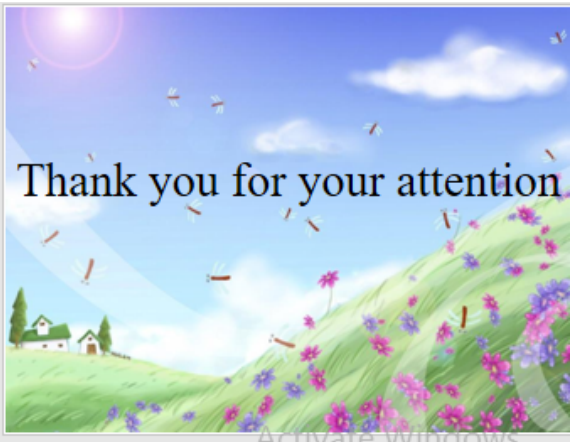
To save fuel
and increase fuel efficiency

1. Modify the trawl net and otter boards

2. Install the higher gear reduction available and larger diameter propeller

(Gulbrandsen, 2012; Wongthongkum, 2013)

19



20

5. Current Situation on Energy Used and Progress on the Utilization Energy Used in Fishing Operation of Viet nam

Current situation on energy used and progress on the utilization energy used in fishing operation in Viet Nam

Ms Nguyen Thi Hong Nhung
Mr Vu Van Tam
Mr Le Doan Tuan Anh
Viet Nam Fisheries Administration

1

MAIN CONTENT

- 1 Viet Nam Fisheries profile
- 2. Current Situation on energy saving in Viet Nam
- 3. The suggestion for engergy saving

2

VIETNAM'S FISHERIES PROFILE

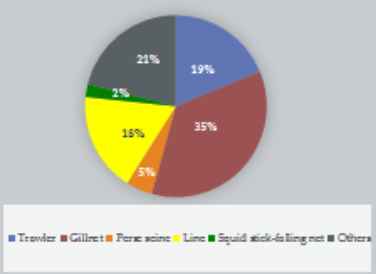
- Coastline of 3,260 km
- EEZ is about 1 mil. Km²
- Population : 90.7 mil. (2014)
- 28/63 coastal provinces
- Taking an important role in the national social economics
- Contribution in GDP about 3%

3

- In 2016, total number of fishing boats was over 110,000 units:
  - Boats >20 HP, about 43% (≈ 48,300 units)
  - Boats >20 HP to < 90HP, about 28% (≈ 31,000 units)
  - Boats > 90HP, about 29% (≈ 30,600 units)

4

FISHING GEARS



5

2. Current situation on energy using

- Almost Fuel is used for going to fishing ground, searching for fish and come to port.
- For Trawl: almost fuel is used for trawling. In Vietnam use 2 boats to trawling, and using big properller which require more fuel.
- Lack of Awareness of energy saving to reduce fishing cost

6

2. Current situation on energy using(Cont)

- Waste time and energy to find the fishing ground
- Lack of knowledge and technology on energy saving
- High cost of fuels and limitted fish resouces
- Awareness of engine maintenance to energy saving

7

2. Current situation on energy using(Cont)

- Using old machine which need more fuel than the new model machine
- Most of engine use diesel
- Almost boats are made by wooden so resistance is bigger and need more fuel to propeller

8

2. Current situation on energy using(Cont)

- Traditional Hull design with slow speed is not yet effective
- Lighting system in fishing not use LED
- Fishing gear is not effective modern

9

3. Suggestion for energy saving

- Reduce the number of trawling
- Reduce time for travelling, searching fish by: using efficient hull design and propreller, install advanced fish-finding equipment
- Using new marine engine
- Using LED lighting system and other alternative fuel use and energy use
- Strengthening the awareness of fishermen about energy saving, engine operation and maintemace

10

TRAINING ON ENERGY AUDITS FOR FISHING VESSELS
Country Report (Philippines)

23-27 January 2017
SEAFDEC-TD

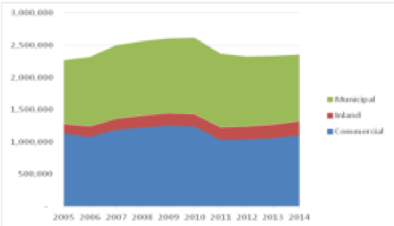
1

Overview of Marine Capture Fisheries

- Commercial fisheries include all fishing operations that use vessels of over 3.1 gross tons (GT).
  - a) Small scale commercial fishing - fishing with passive or active gear utilizing fishing vessels of 3.1 gross tons (GT) up to twenty (20) GT;
  - b) Medium scale commercial fishing - fishing utilizing active gears and vessels of 20.1 GT up to one hundred fifty (150) GT; and
  - c)Large scale commercial fishing - fishing utilizing active gears and vessels of more than one hundred fifty (150) GT.
- Municipal fisheries, on the other hand, involves the use of vessels of 3 GT or less as well as fishing operations that do not use fishing boats.

2

Fisheries production (in tonnes) in the Philippines
CY 2005-2014 (Philippine Statistics Authority)



3

Fishing Fleet (As of May 2016)

FISHING GEARS	TYPE			GRAND TOTAL
	LARGE	MEDIUM	SMALL	
Ring Net		[illegible]	[illegible]	[illegible]
Trawl		[illegible]	[illegible]	[illegible]
Handline		[illegible]	[illegible]	[illegible]
[illegible] Purse Seine	[illegible]	[illegible]	[illegible]	[illegible]
Tuna Purse Seine	[illegible]	[illegible]	[illegible]	[illegible]
Bag Net	[illegible]	[illegible]	[illegible]	[illegible]
Longline	[illegible]	[illegible]	[illegible]	[illegible]
Push Net		[illegible]	[illegible]	[illegible]
[illegible] Seine	[illegible]	[illegible]	[illegible]	[illegible]
Gill Net		[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] Seine	[illegible]		[illegible]	[illegible]
Others	[illegible]	[illegible]	[illegible]	[illegible]
Grand Total	[illegible]	[illegible]	[illegible]	[illegible]

4

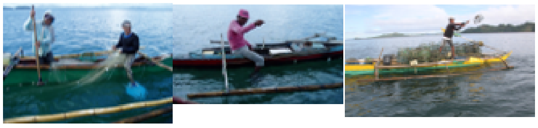
Commercial Fishing Boats

- Major commercial fishing gears used are ring net, trawl, handline, purse seine, bag net and longline.

5

Municipal Fishing Boat

- Municipal Boat Registration (Boat R) was launched in 2015
- A total of 178,000registered municipal fishing boats (2016)
- The most common fishing gears used in municipal fisheries are hook-and-line, gillnets, cast nets, traps/pots, beach seine and fish corral



6

Trawl Fisheries Industry

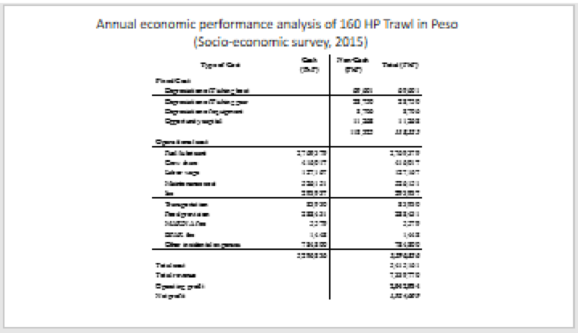
- Municipal trawlers (3GT and below)
  - LOA measures 5-12 meters
  - Powered by 7-16 HP gasoline or diesoline engines
  - Operated by 1-2 crew at shallow and nearshore areas
  - Short fishing trip normally leaves in the late afternoon and returns the following morning

7

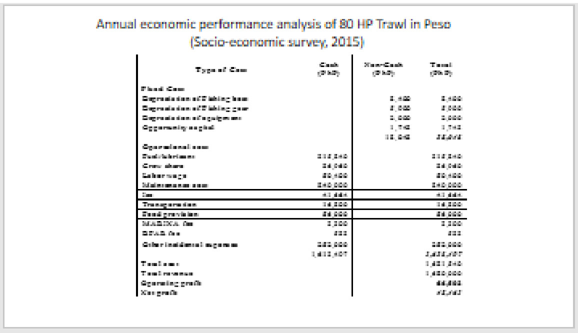
Trawl Fishery Industry (cont'd)

- Commercial trawlers
  - Small commercial (3.01 GT-20GT)
  - Medium commercial (20.01GT-150GT)
  - Large commercial (150GT-above)
    - LOA exceeds 12 meters and powered 80-160 HP diesel diesoline engines
    - Mechanized where winches and pulleys are rigged for hauling
    - Fishing trip last for 2-4 days

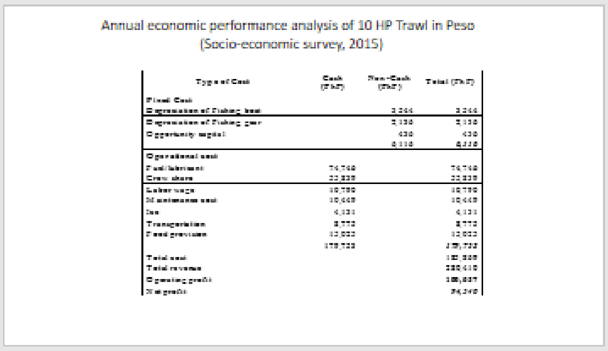
8


Annual economic performance analysis of 160 HP Trawl in Peso
(Socio-economic survey, 2015)

9


Annual economic performance analysis of 80 HP Trawl in Peso
(Socio-economic survey, 2015)

10


Annual economic performance analysis of 10 HP Trawl in Peso
(Socio-economic survey, 2015)

11


Thank you
Activate Windows

12