Energy Efficiency Measure for Small Fishing Vessels

Presentation by

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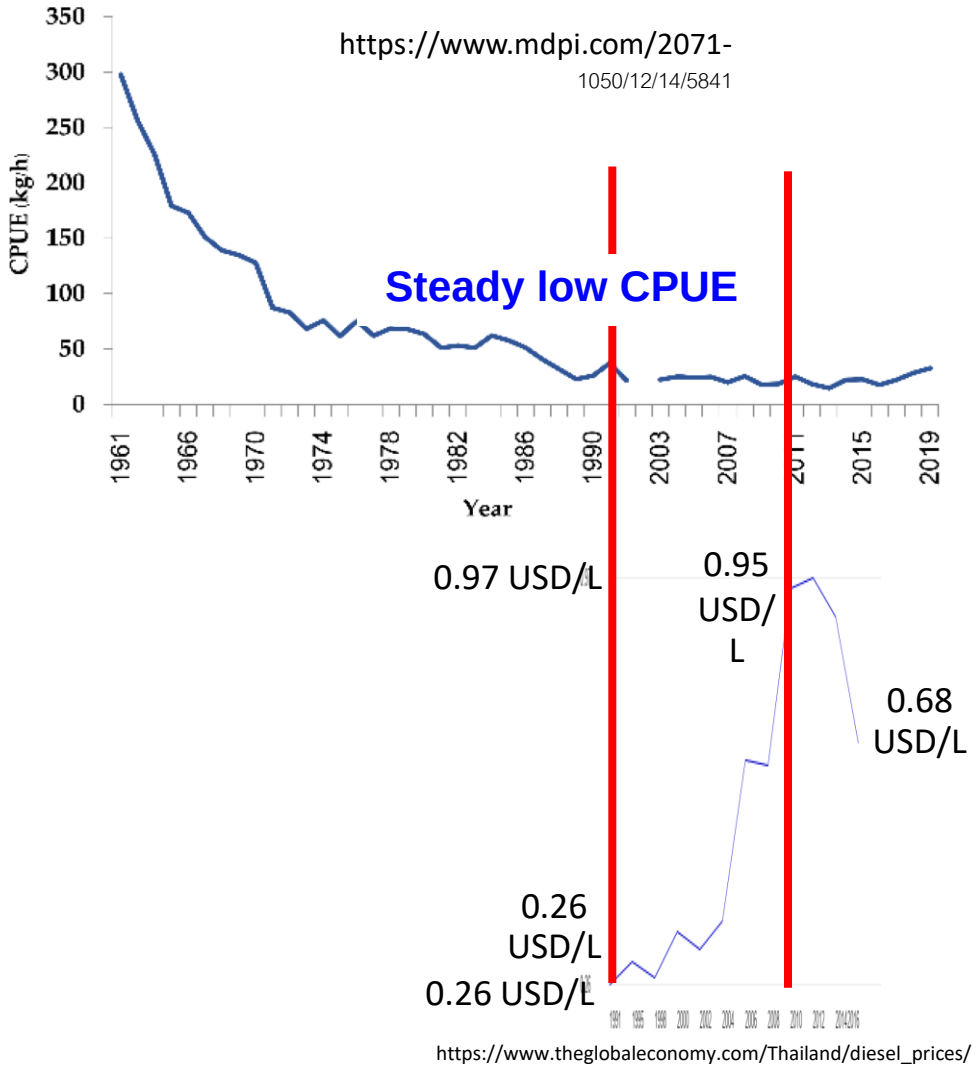
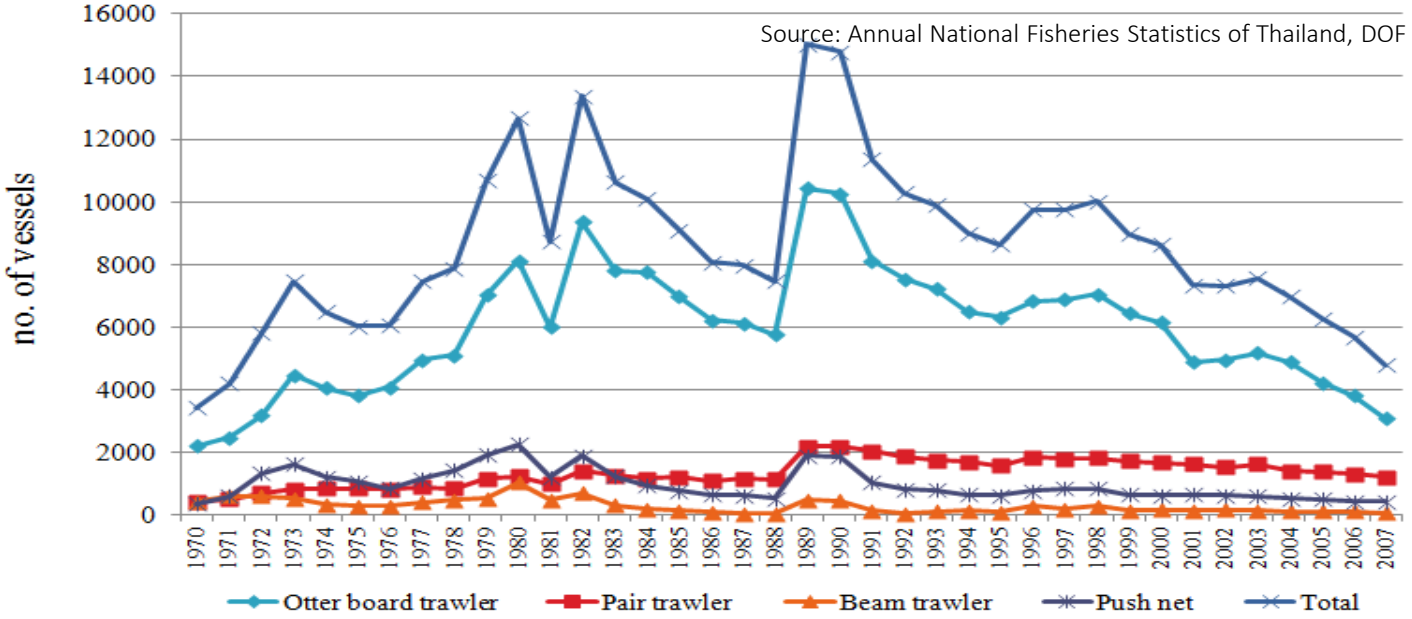
Trend of Crude oil, CPUE, and No.of fishing Vessels of Thailand





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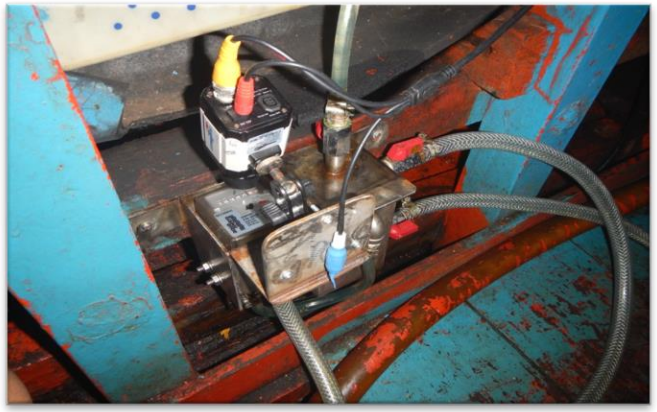
FAO AND SEAFDEC INITIATIVES ON FUEL AUDITS ON THAI TRAWL FISHING VESSELS PHASE I,II & III (2015-2018)



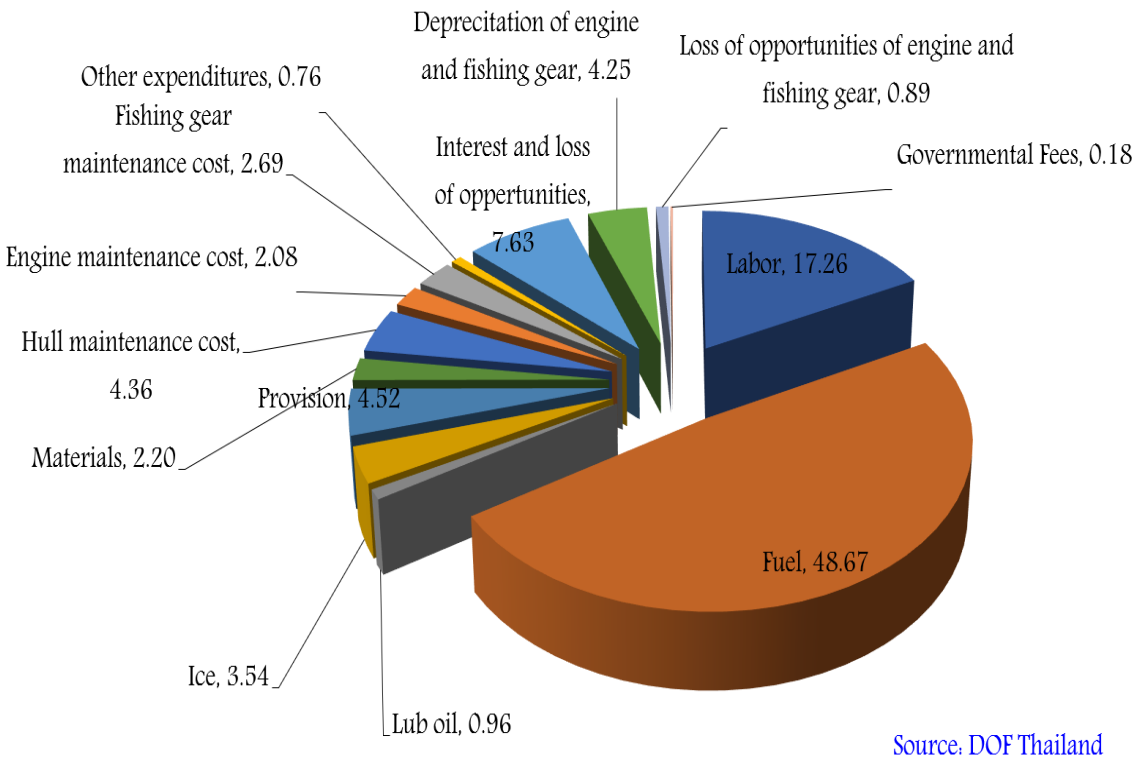
GOALS

Dependence on fossil fuels investment/requirements in fisheries (fishing boats) in the SEA region will be reduced

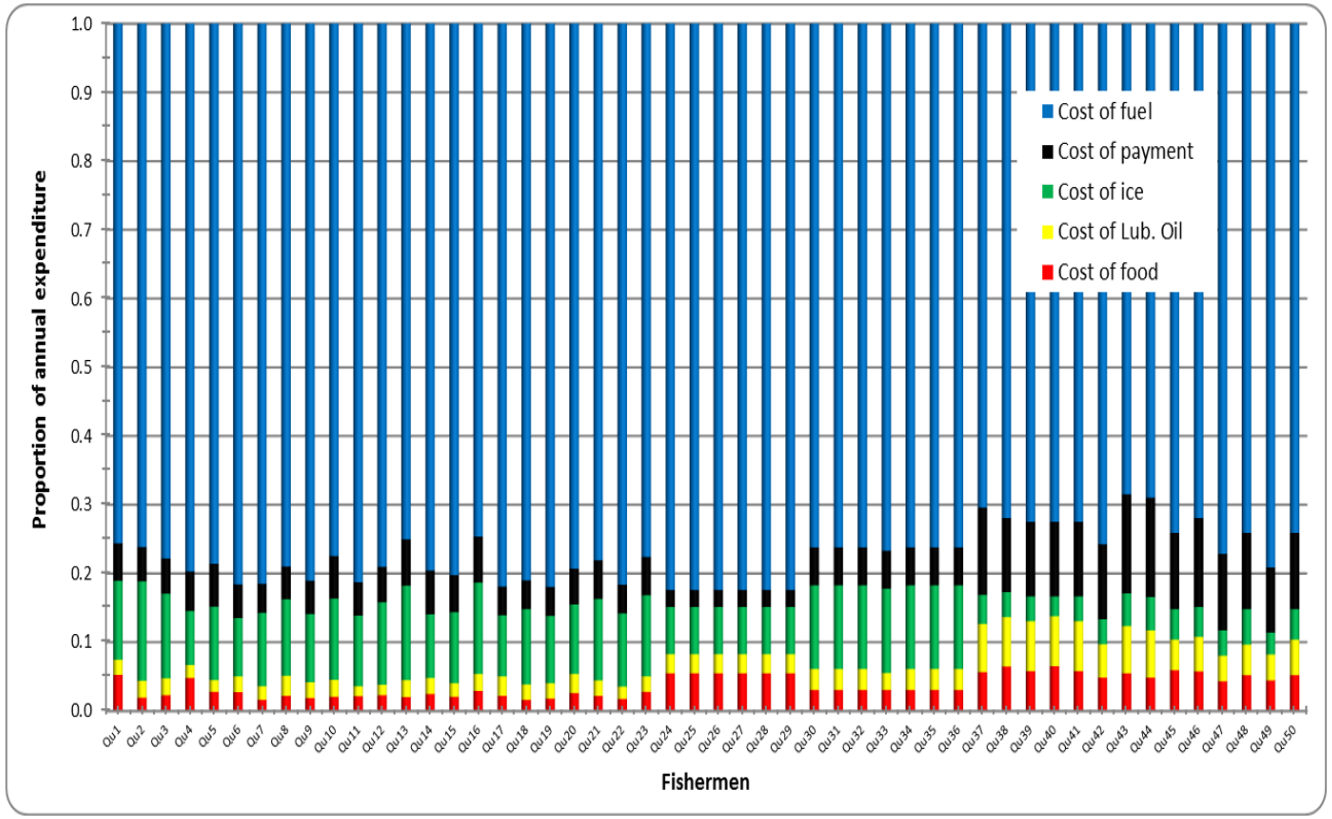
OBJECTIVES

- To estimate and optimize fuel consumption and CO_2 emission of fishing vessels
- Assessment of the use of fuel consumption in fishing operation through impact to fishermen
- Guidance on decreasing fuel consumption through appropriate adjustments and modifications to fishing boats, fishing gears, and fishing operation processes

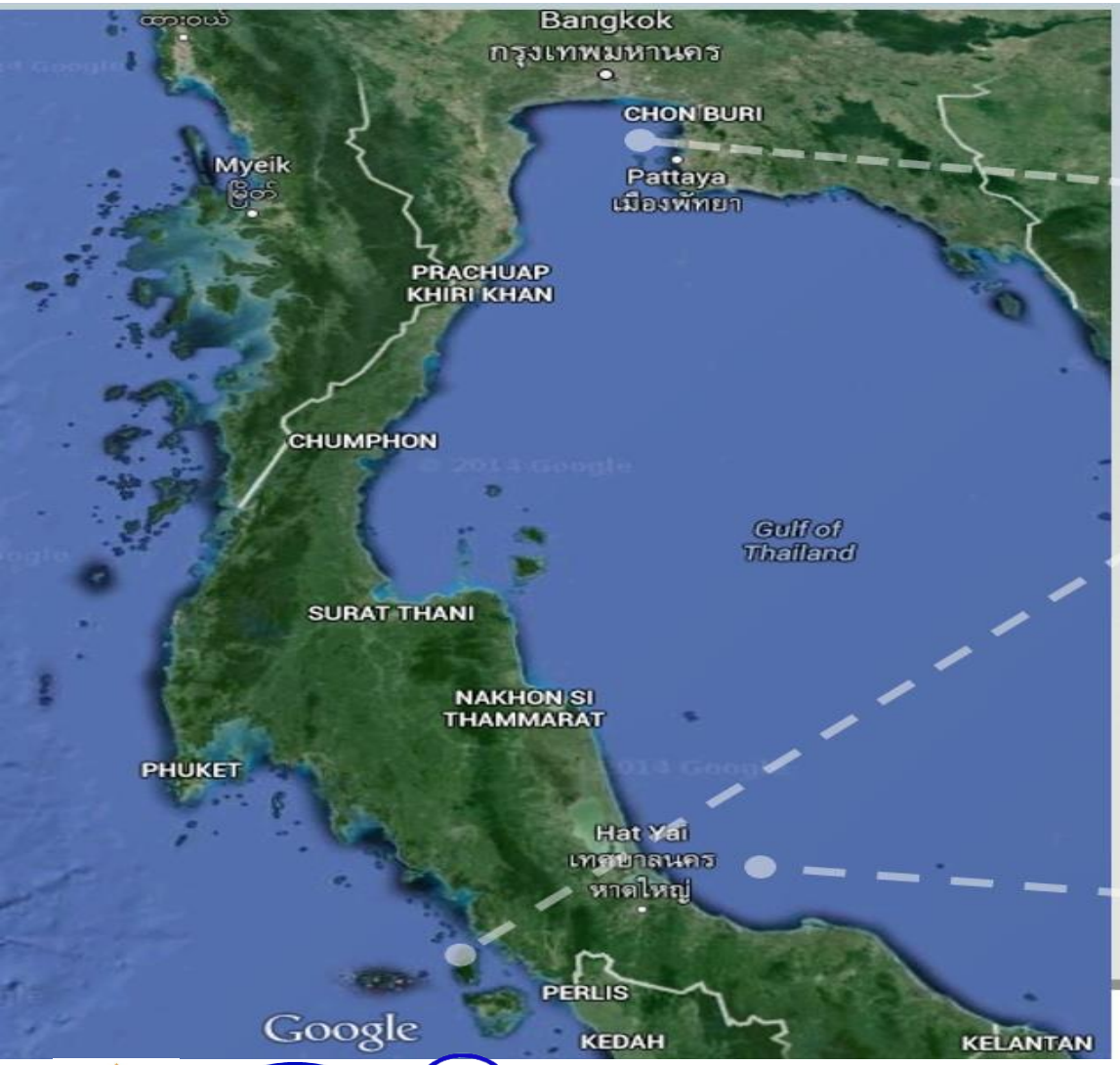
Expenditures of small trawl fishing boats < 14 m, >18m

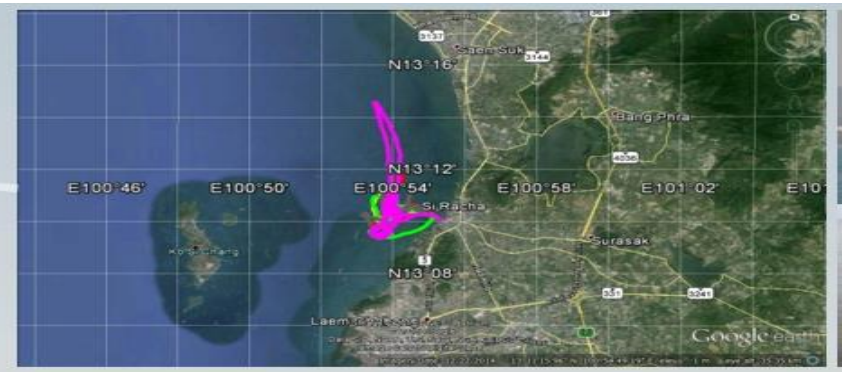


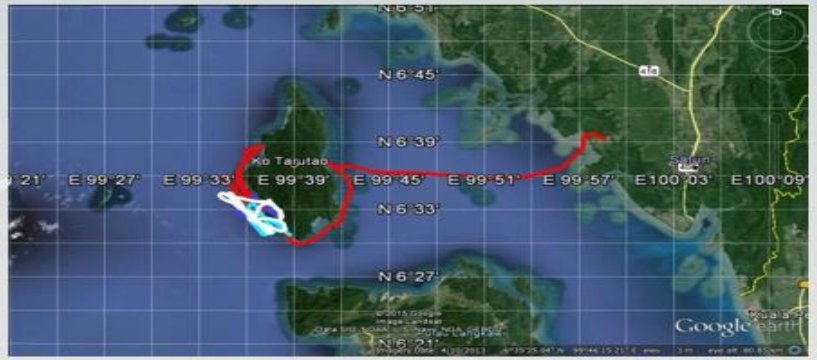
Source: DOF Thailand

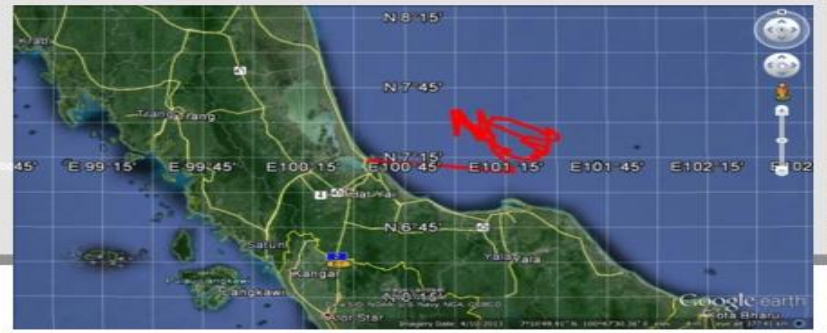


Six Demonstrated Trawlers Both Sea Water of Thailand (LOA <14m, LOA 14-24m, LOA >24 m)









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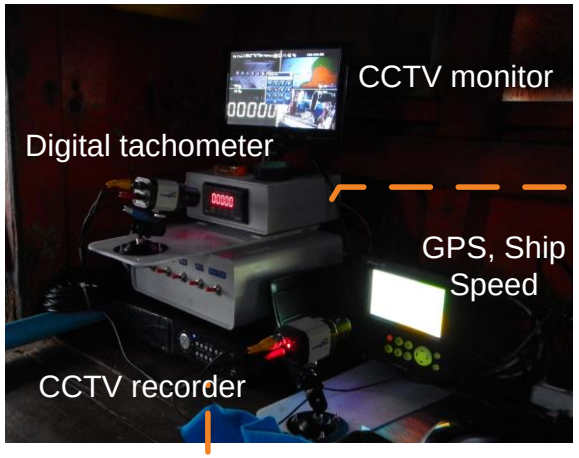
Tools and equipment for auditing fuel consumptions on trawl fishing vessels



Revolution line

Wind speed measurement

CCTV Camera line

Diesel Main Engine

Diesel Oil Tank

Fuel tank line

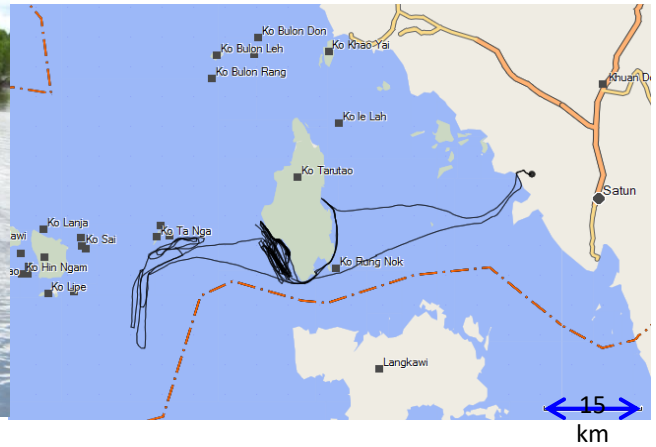
Fuel supply line

Fuel return line

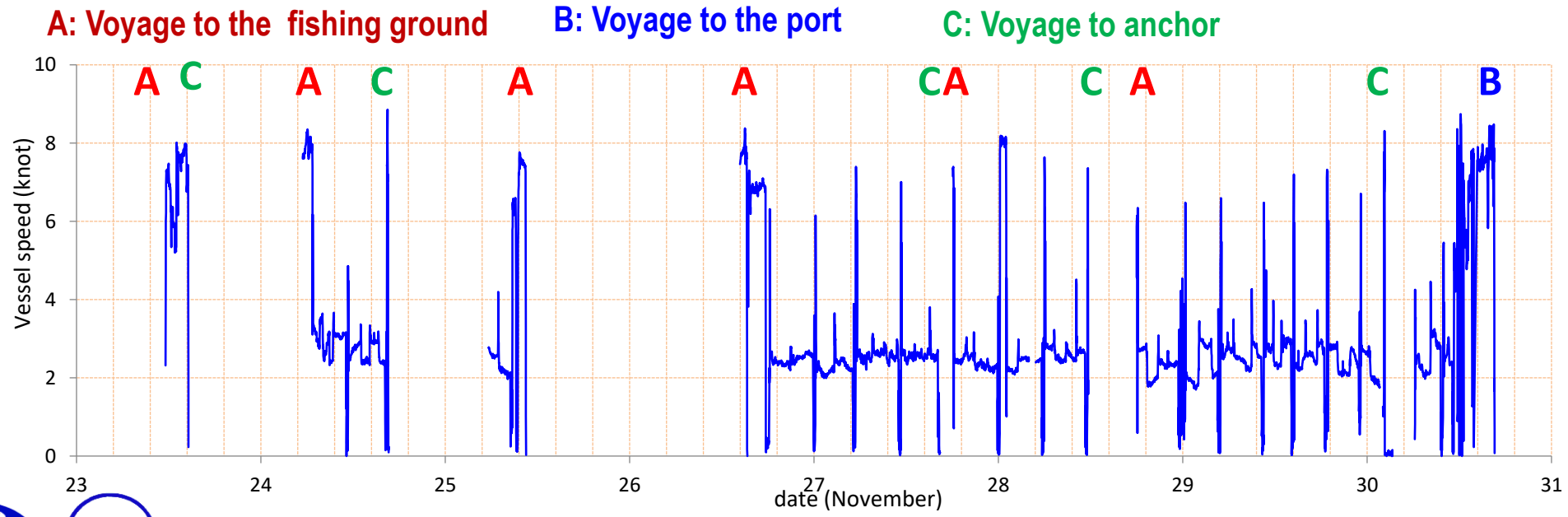
Fuel oil meter with small fuel accumulator

Water current measurement

Fuel consumption profile when fishing operation of Por Deangchareanchai



Speed during streaming: 5.5-8 knot
Speed during trawling: 2-2.5 knot
Fishing trip: 10 days



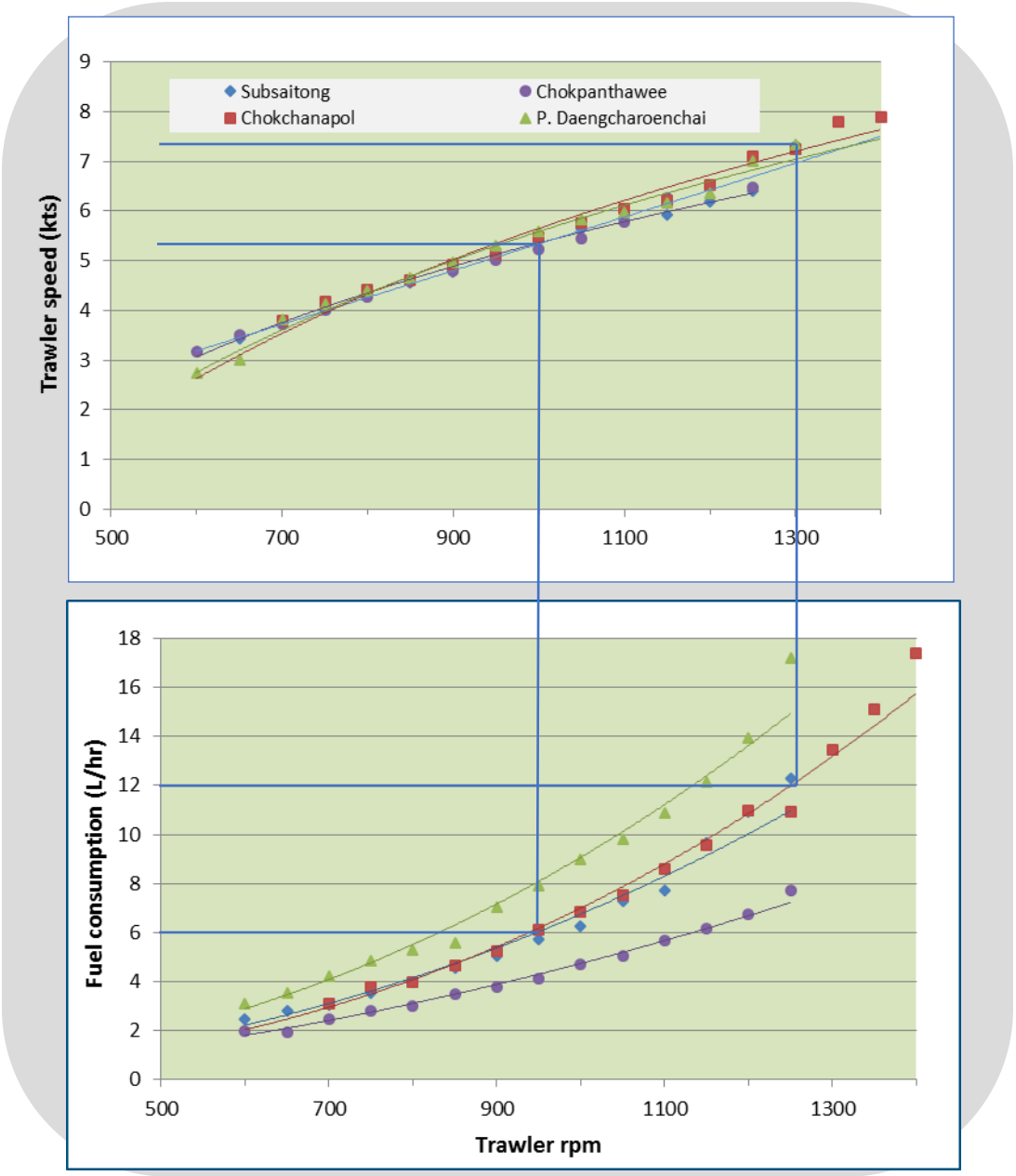
Steaming

- 7 to 5 kts; 50% saving
- 150 THB/hr saving
- 445 THB/hr catch

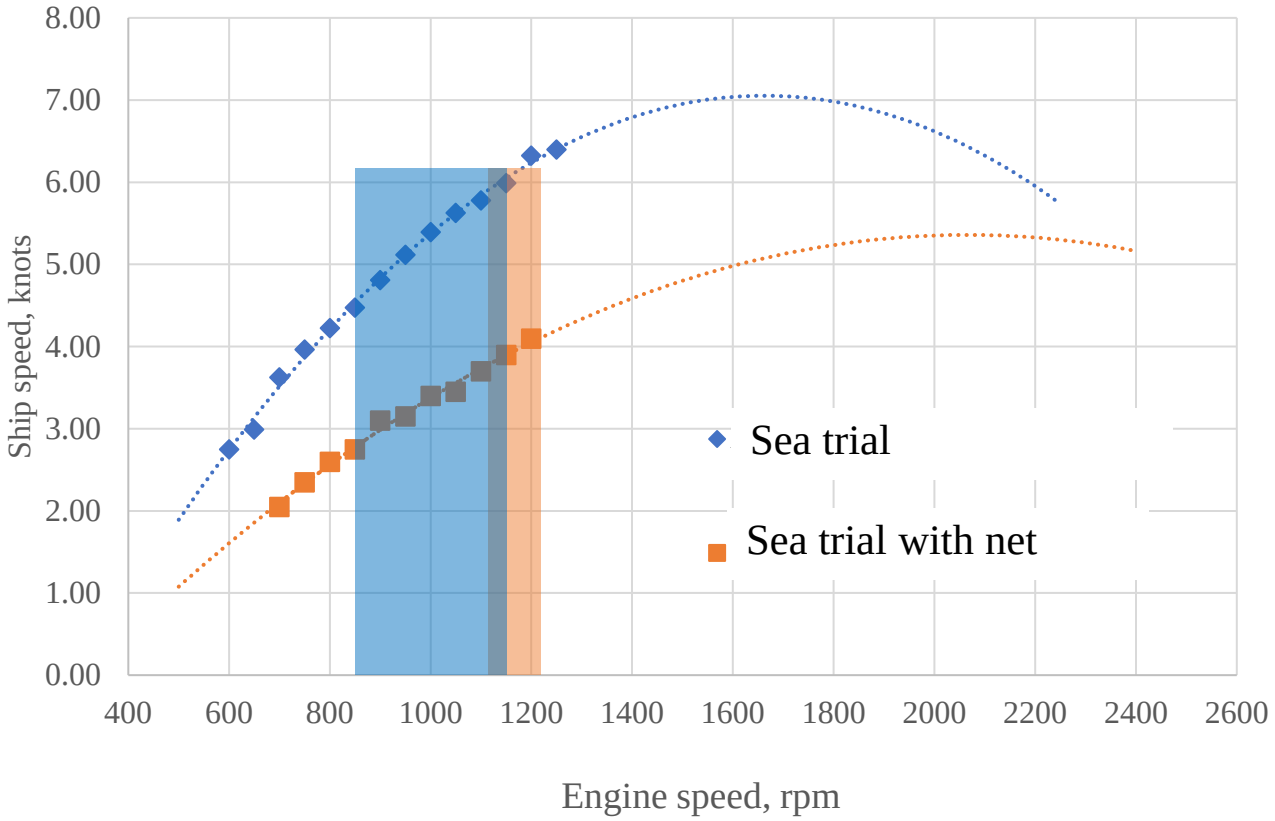
Note:

Diesel oil : 25 THB/L

- Repeated for trawling

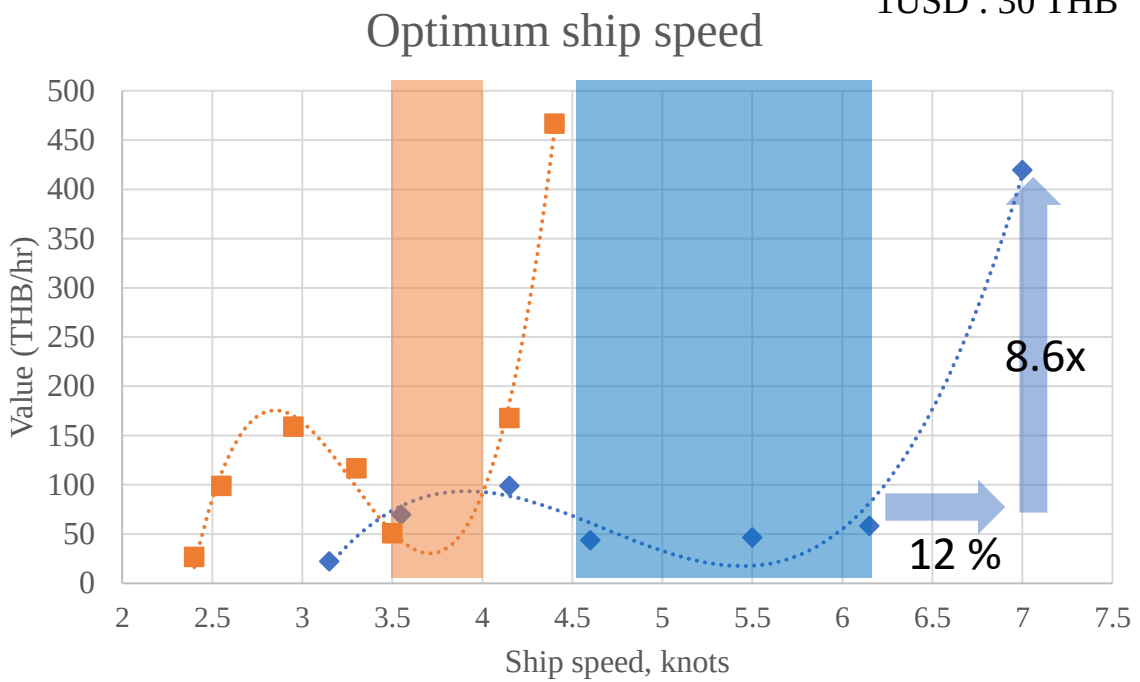


Optimum ship speed and Time Value of Por Deangchareanchai

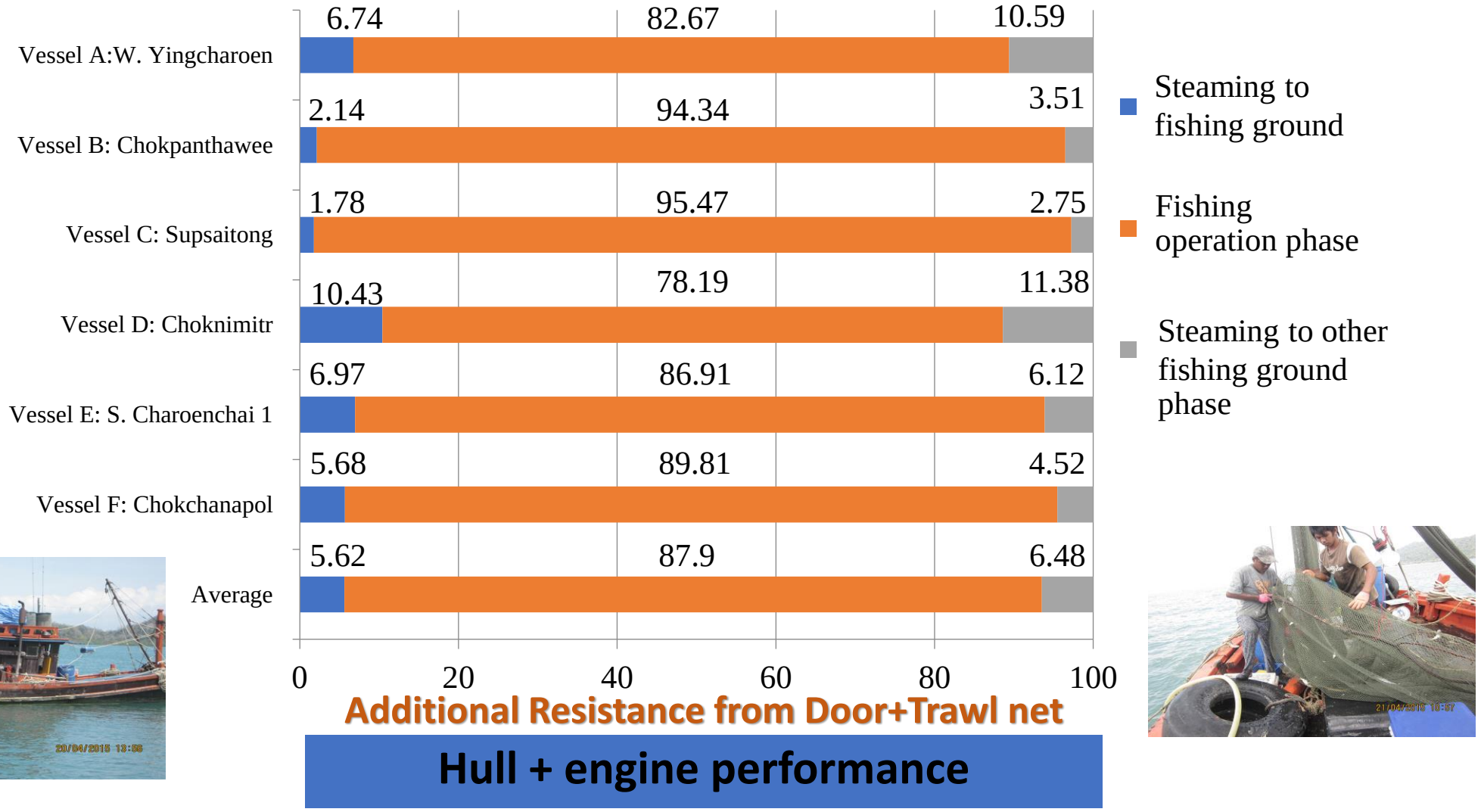


Sea trial : 4.5- 6 knot, 900 – 1100 rpm
Sea trial with net : 3.5-3.7 knot, 1000 – 1100 rpm

Diesel oil : 25 THB/liter
1USD : 30 THB

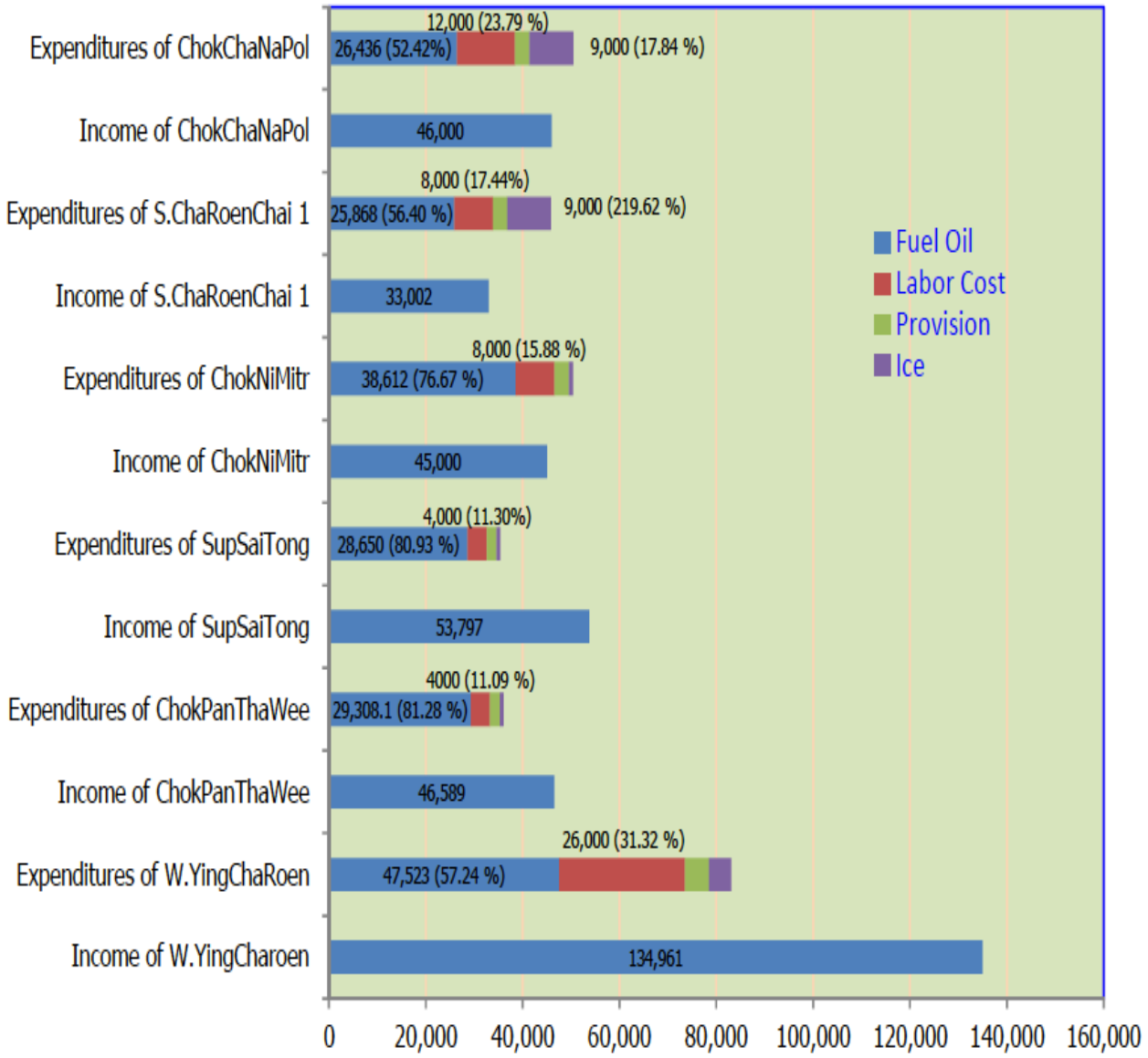


PERCENTAGE OF FUEL CONSUMPTION DURING FISHING TRIP



Additional Resistance from Door+Trawl net

Hull + engine performance



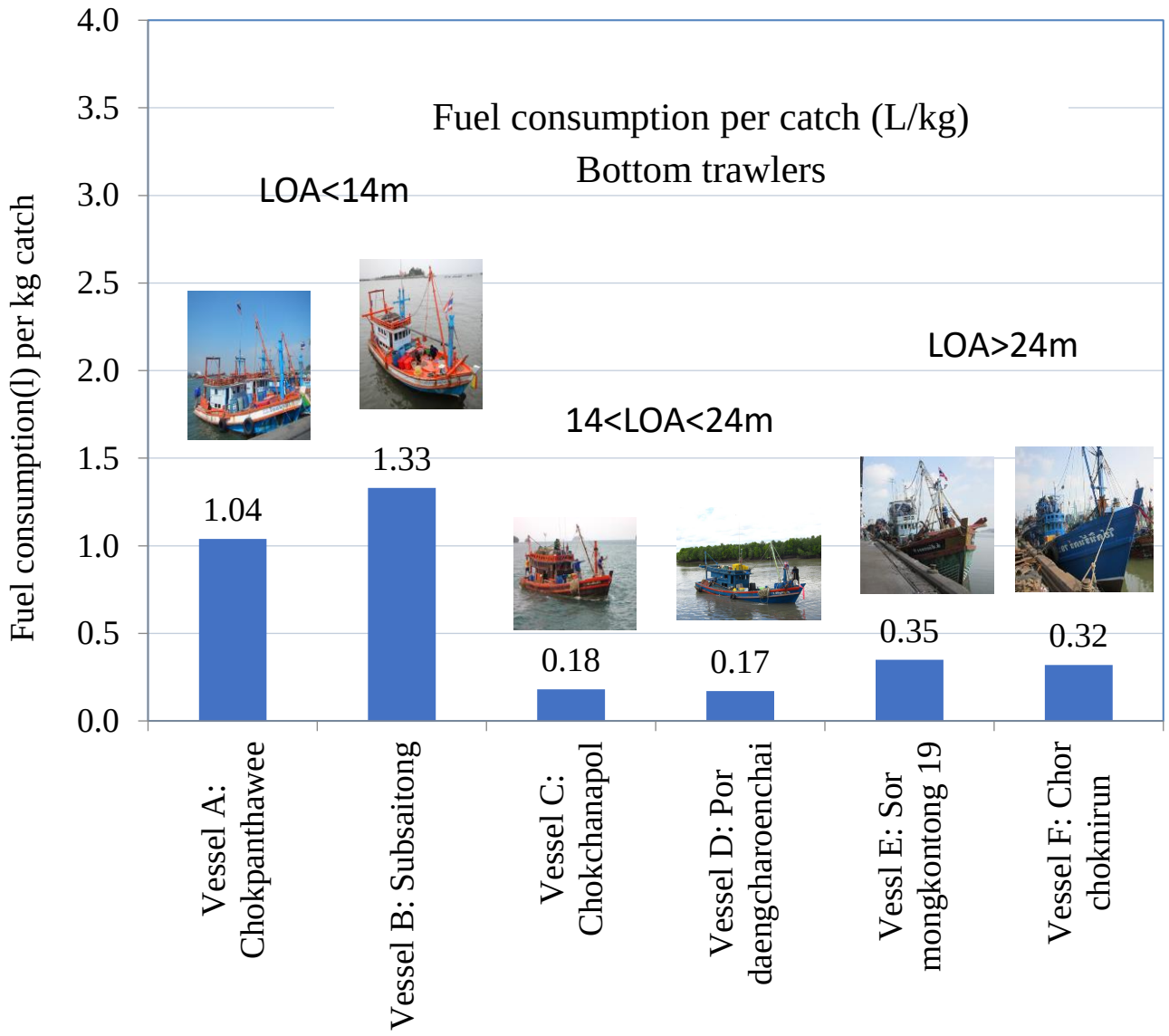
Economic perspectives:

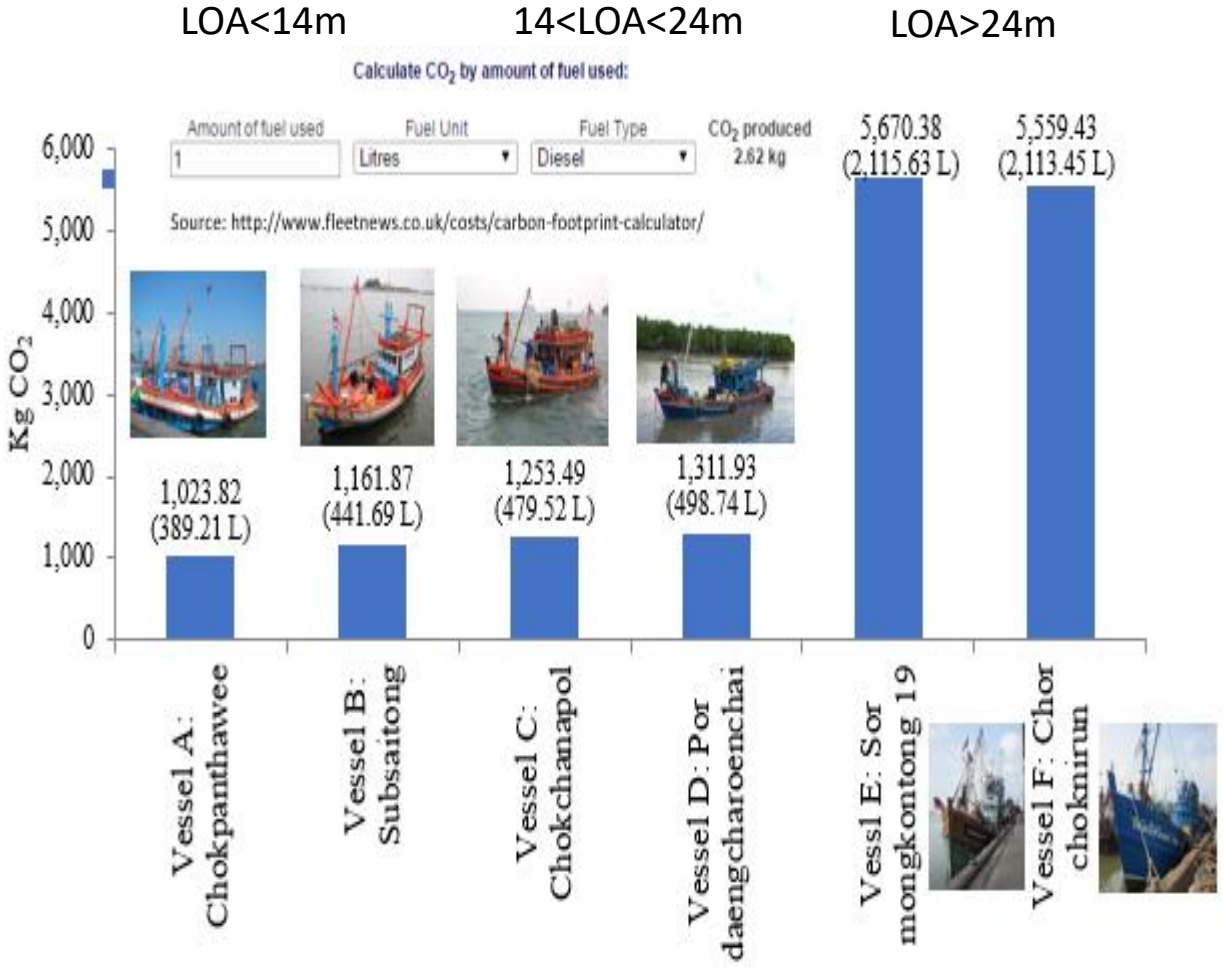
- Experience of fisherman
- Difference revenue of trawlers
- Fuel cost: 50-80% of total cost
- Fishing Season:

  Abundance of fishing ground
- High value target catches:

  live blue swimming crab
- Efficiency of trawl fishing boat, gear

CATCH PERFORMANCE AND CARBON EMISSION COSIDERATION





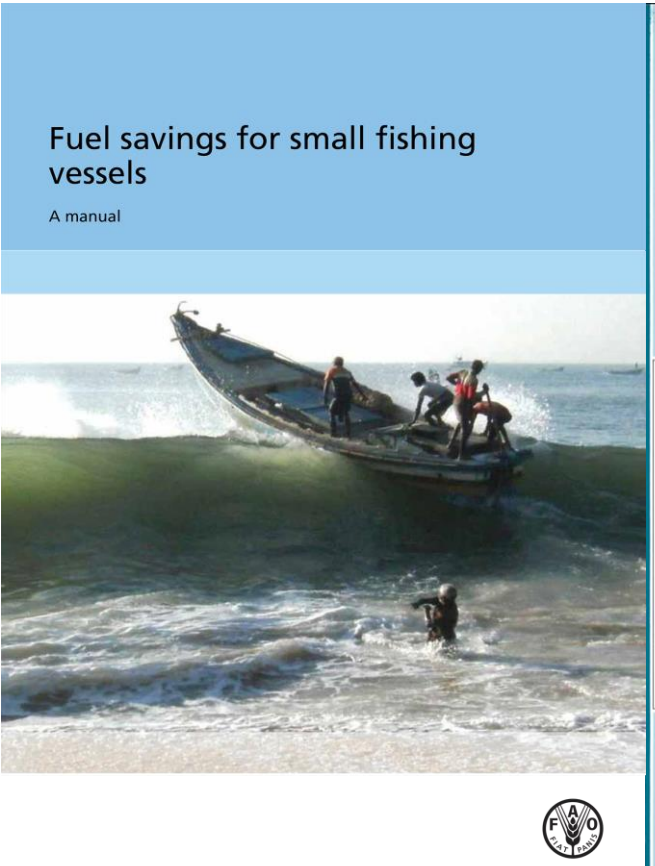
POTENTIAL SOLUTIONS AND RECOMMENDED FUEL SAVING OPTIONS

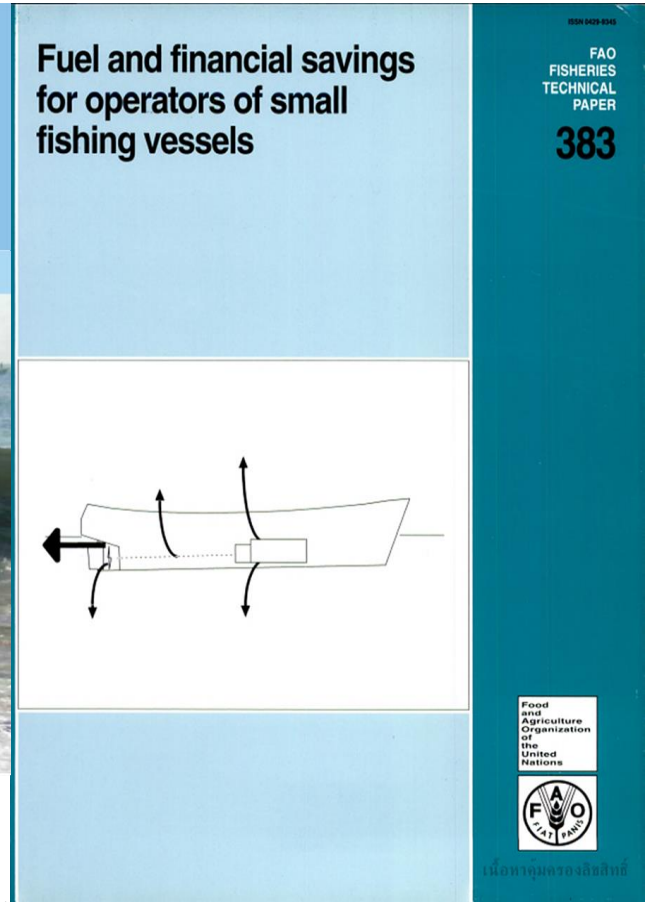
Recommendation	Small trawler (<14 m)			
	Est. cost (USD)	Est. annual fuel saving (%)	Est. annual fuel saving (THB)	Est. payback period (years)
Reduce engine revolutions	0	5	37,500	-
Install fairing pieces	500	5	37,500	0.43
Reduce underwater fouling	1,000	5	37,500	0.87
Modify ventilation to engine room	1,000	5	37,500	0.87
Install streamlined rudder	2,000	5	37,500	1.73
Install fuel flow meter	3,000	15	112,500	0.87
Install more efficient propeller	5,000	15	112,500	1.44
Install larger mesh netting or finer twine	5,000	10	56,250	2.89
Install autopilot	8,000	5	37,500	6.93
Install hydrodynamic otter boards	8,000	10	56,250	4.62
Install propeller nozzle	20,000	20	150,000	4.33
Incrase waterline length	30,000	15	112,500	8.66

A STAKEHOLDER MEETING IN SATUN PROVINCE (A PILOT SITE)

- Dissemination of the results of the energy consumption scale carried out on the demonstration fishing vessel
- Raising awareness of fishermen about more efficient use of energy
- Engage stakeholders in a dialogue to gather their perspectives on resolving energy cost and CO_2 emission challenges

THE MAIN REFERENCE DOCUMENTS THAT PROVIDES GUIDANCE FOR ENHANCING THE ENERGY EFFICIENCY OF SMALL FISHING VESSELS





Optimizing Energy Use in Fisheries in Southeast Asia

Bundit Chokesanguan

In terms of geographical features, the total length of the coastlines of Southeast Asia is estimated to be about 112,699 km while the total EEZs is about 9,407,999 km². The continental shelf which is the stretch of sea beds adjacent to each country also known as territorial waters is 3,523,398 km². This scenario makes fishing an important activity especially in the coastal areas of Southeast Asia except Lao PDR being land-locked which is solely engaged in inland capture fisheries and aquaculture. In the region, fossil fuels are used not only for commercial fishing boats such as the super-trawlers, but also for powered small-scale boats especially those that operate beyond the countries' EEZs. This specifically means that fossil fuel inputs are now increasingly being used to harvest the fishery resources in order to increase fishery production. The increasing use of fossil fuels by fishing boats led to increased emission of CO_2 which is the carbon footprint of fishing boats. Since the boat's carbon footprint is directly proportional to the amount of fuel burned, it is therefore necessary to reduce the use of fossil fuel to minimize the fishing boat's carbon footprint and subsequently reduce the emission of CO_2 a major greenhouse gas (GHG) that contributes heavily to global warming.

The seas of Southeast Asia form part of the South China Sea, constituting about 2.5% of the world's oceans, and bordered by Brunei Darussalam, Cambodia, China, Hong Kong, Indonesia, Malaysia, Philippines, Singapore, Taiwan, Thailand and Vietnam. The seawaters which surround the Southeast Asian countries include the Andaman Sea, Gulf of Thailand, Strait of Malacca, Indian Ocean (eastern part), South China Sea, Philippine Sea, Celebes Sea, Java Sea, Arafura Sea, Makassar Strait, and Timor Sea. On the other hand, Lao PDR is the only country in the Southeas region which is land-locked but is endowed with enc internal water areas from the Mekong River which f large part of its western boundary with Thailand.

The region's EEZ and internal waters (**Table 1** great potentials for exploitation by the fisheries which plays an important role in supplying proteir populations, generating income and employmer stimulating economic growth. In 2007, the total production of the Southeast Asian countries was 25,2 mt valued at US$ 23,938 million. The quantity ex by the countries was 7,369,862 mt valued at US$ million (**Table 2**).

Table 1. Geographical features of the Southeast Asian countries

Countries	Length of coastline[a] (km)	Exclusive Economic Zone (EEZ)[b] (km²)	Continental shelf[b] (km²)	EEZ + internal wa (km²)
Brunei Darussalam	161	10,090	8,509	15,855
Cambodia	443	62,515	62,515	243,550
Indonesia	81,000	6,159,032	2,039,381	8,019,392
Lao PDR	-	-	-	236,800
Malaysia	4,675	334,671	323,412	665,474
Myanmar	2,832	532,775	220,332	1,209,353
Philippines	17,460	1,590,780	272,921	1,890,780
Singapore	224	1,067	1,067	1,772
Thailand	2,614	299,397	230,063	812,517
Vietnam	3,260	417,663	365,198	748,875
TOTAL	112,669	9,407,990	3,523,398	13,844,368

Sources:
[a] *SEAFDEC Fishery Statistical Bulletin for the South China Sea Area: 2007*
[b] *United Nations Law of the Sea (1982)*

Fishing Vessels Energy Audit: Operational Benchmarking of Fuel Consumption in Southeast Asian Trawl Fisheries – Pilot Project in Thailand

Bundit Chokesanguan, Steve Eayrs and Suthipong Thanasarnsakorn

Despite the increasing demand for fish and fishery products in view of their importance to human well-being, global fisheries production is at risk of falling off due to escalating and volatile fuel prices. Since the turn of the 21st century, the real global price of fuel has more than doubled and is characterized by unparalleled volatility. Rising fuel prices have also generally outpaced increases in fish prices (Gulbrandsen, 2012), making it difficult to offset this differential without landing more fish per unit of fuel consumed or reducing other fishing costs. Subsequently, the profitability of many fishers in Southeast Asia is under threat, jeopardizing the livelihoods of fishing families, communities, and others that directly rely on wild-caught seafood. The high consumption of fuel by the commercial fishing industry is also a concern because of its link to greenhouse gas emissions and climate change. According to Tyedmers ***et al.*** (2005), the global commercial fishing industry produces approximately 1.7 tons of greenhouse gas emissions for every 1.0 ton of live-weight seafood, and is responsible for over 1% of the greenhouse gas emissions from all sources combined. Starting in late 2013, FAO and SEAFDEC launched a Fishing Vessel Energy Audit Pilot Project in response to concerns on high and variable fuel costs, and associated greenhouse gas emissions from Thai commercial fishing industry. The project was aimed at evaluating fuel consumption in single-boat trawl fleet and identifying potential fuel savings through energy efficient fishing operations and practices. This Project also applied energy audits to trawlers in single-boat trawl fleet. It is envisioned that results of this pilot project could also be adapted in other countries of Southeast Asia to ensure that trawl fisheries is not only cost-effective but also environmentally efficient.

Fishing Vessel Energy Audit Pilot Project

The Training Department (TD) of the Southeast Asian Fisheries Development Center (SEAFDEC) in collaboration with the Food and Agriculture Organization of the United Nations (FAO) launched a Fishing Vessel Energy Audit Pilot Project in Thailand starting in November 2013. The Project surveyed the trawl fisheries in the Provinces of Chon Buri, Rayong, and Trat in the eastern Gulf of Thailand, and Prachaup Khiri Khan and Chumphon in the central Gulf of Thailand, to identify fuel-saving potentials through energy efficiency practices. Based on other experiences on fishing vessels energy audit and management plans, fishing vessels have the potential to reduce their energy use by 15-40% through improved efficiency. As envisioned, this pilot project on fishing vessel energy audit could provide a description of the energy usage patterns of fishing vessels for different operational phases and/or through a fishing season; potential energy saving measures together with expected payback periods; and measures of performance against recognized energy audit parameters, such as catch quantity per liter of diesel-fuel and fuel expense against catch revenue. Such information is necessary in order that fishing companies could undertake rational change towards energy saving practices and technologies. Furthermore, results of the fishing vessel energy audit could also address the concerns of the government sector as well as non-government organizations on the performance of the fishery sector as a primary industry, not only in terms of energy efficiency and viability but also its possible contributions to the increasing greenhouse gas emissions and carbon footprint.

The pilot project made use of the energy audit protocol based on a three-level audit process developed for Australian fishing vessels (**Box 1**). This process was designed to systematically collect data on fishing vessel design and operation, machinery specifications, and fuel consumption, in order that a prioritized, focused, and cost-

Map of Thailand

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FUEL-SAVING RECOMMENDATIONS FOR SMALL FISHING VESSELS BASED ON THE PROVIDED DOCUMENTS

External Factors Affecting Fuel Efficiency of Fishing Vessels

Water resistance, Wave making resistance, wind resistance:

- Reject unnecessary weight
- Use optimum vessel speed
- Decrease water resistance
  - hydrodynamic improvements by remodeling hull shape, appendages, bulbous bow, aerodynamic of upper deck, steam line of astern hull shape, low astern wage, etc.
  - bigger mesh size of fishing net
- Maintain the stability of the fishing vessel

Internal Factors Affecting Fuel Efficiency of Fishing Vessels

Loss or inefficiency in fuel consumption and propulsion system:

Inefficient performance of the diesel engine:

- Issues with the fuel injection system
- Problems with the cooling system, such as blockages in the heat exchanger or malfunctioning water pump

Ineffective performance of the propeller:

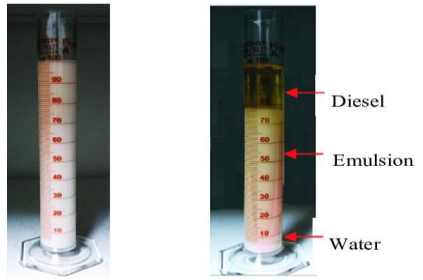
- Damaged or broken propeller blades
- Impact of the cavity effect
- Inappropriate propeller diameter selection
- Absence of a ducted propeller system

Inefficient performance of the refrigeration system:

- Leakage or degradation of the insulation in the fish hold, among other potential issues.

Ways and means of reducing the use of fossil fuel in fisheries

- Alternative fuel use
  - LPG
  - LNG
  - CNG
  - Hydrogen, HHO
  - Bio-diesel
  - Diesel-water emulsion*
- Alternative energy use
  - Wind
  - Solar



(a) Stable emulsion (b) Clear separation

https://www.mdpi.com/1996-1073/11/9/2281

Thank You very much for your kind attention

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