Motorized fishing contributions to climate change

Leela Edwin and Dhiju Das P.H.

ICAR-Central Institute of Fisheries Technology, Cochin

Until three decades ago small pelagic fish stocks of the south west Indian coast were exploited mainly by artisanal fishermen employing traditional gears such as the boat seine, shore seine, gillnets and other gears operated from plank-built canoes. To counter the sidelining of the traditional fisheries sector by the strongly emergent mechanized sector, the early eighties witnessed the introduction of the mini purse seine (ring seine) in the artisanal fisheries sector (Panicker, 1985). Subsequently, it became the most popular gear among traditional fishermen. At present, ring seiners of Kerala can be classified into motorized (using outboard motor, OBM) ring seiner and mechanized (using inboard motor, IBM) ring seiner. The mechanized ring seiners are mainly targeting species like mackerel, sardine, prawns, pomfret, etc. and motorized ring seiners target sardine, anchovy, prawns etc. In Kerala, nearly 80% of fish are landed by trawls and ring seines (ICAR-CMFRI, 2016).

The introduction of a lightly constructed purse seine (ring seine) by the ICAR-Central Institute of Fisheries Technology (ICAR-CIFT) for the traditional plank-built canoes by the artisanal fishermen, has now become a landmark event in the history of Indian fisheries. Though 300 ring seines were recommended for use by ICAR-CIFT in 1985 (Panicker, 1985), there were 2277 units in Kerala, providing work for more than half of Kerala's active fishermen by 1998 (SIFFS, 1999). The ring seines dominated the fishery and caused major setback to the non-motorized traditional boat seine operations. This system of fishing was so successful that it is now the dominant technique in the state of Kerala and has spread along parts of the west and east coasts of the country.

At the time of introduction, ring seines were operated from small canoes with very low power engines. Presently ring seines are operated from high powered motorized and mechanized vessels. Recent studies reveal that in the past 30 years the size of the ring seines have grown at least three to four times in proportion to the extent of about 800 to 1500 m ring seine operated from 20-24 m wooden/ steel/ Fiberglass Reinforced Plastic (FRP) fishing vessels with 350-440 hp engines for mechanized ring seine operation and 500 to 650 m ring seine operated from 7-16 m FRP or wooden vessels with one or two 9.9/ 25 and/or 40hp engines for motorized ring seine operation (Edwin and Das, 2015). The ring seine operation uses small motorized vessel propelled by OBMs as skiff for assistance in fishing operation and transfer of catch to the landing centre.

The larger unit size increased the operational expenses for fuel, labour, daily operational allowance to the fishing crew, transportation, maintenance and repair. The high cost of fuel accounts for the high operational expenditure. OBM ring seiners which depend on petrol for starting the engine and kerosene for running, faced an increase of 800% cost for petrol and 2100% for kerosene since 1986. Diesel prices increased by 1500% since 1986. It is estimated that 62 - 66% of the total operational cost in OBM operated vessels is spent on fuel and 70 – 80% in IBM craft. While a motorized ring seine unit would use 150 liters of kerosene for production of one tonne of oil sardine landing, the fuel consumption would be 112 liters per ton of fish landed in a mechanized vessel.

One tonne of oil sardine - one of the most sought after fish variety in Kerala - when fished and brought to shore in a kerosene-fueled motorized vessel, would release 402 kg Carbon dioxide into the atmosphere. Carbon emissions would be lower (300 kg of carbon dioxide for every tonne of sardine) for a mechanized vessel which uses diesel engine for the catch.

So far in India, fishing impacts were

calculated through the direct effect towards the fishing area and to the targeted species. Apart from the targeted species, the impact of fishing methods go well beyond to the environmental burdens. In this scenario ICAR-CIFT, Cochin conducted software-based energy analysis in relation to fisheries Life Cycle Assessment (LCA) and carbon foot print studies to quantify the scale and importance of emissions in fisheries sector.

An LCA methodology is used to analyze the environmental burdens associated with mechanized and motorized ring seine fishing systems. This analysis encompassed operational inputs to fishing activities, inputs to fishing craft and gear construction, maintenance and service life of fishing system. This is done using material-wise analysis for ring seine fishing systems in detail and it is the first of that kind in Indian fisheries sector. During the LCA analysis for individual fishing unit including vessel and gear, the energy, raw material and ancillary inputs, other physical inputs, products, co-products and waste generated from the construction of the vessel to the landing of the catch were evaluated. The quantity of materials like steel used in hull, engine, propeller and shaft of the vessels, welding rod, electricity for welding and grinding, powering lamps, plywood for deck, wooden material, use of alloy for propeller, fiber glass mat, resin, other ingredients like paint primer, paint and antifouling paint were also taken into account. Studies in this regard show that in ring seine landing, fuel used for fishing contributed more than half of the total impacts in eight out of the ten impact categories analyzed. Motorized ring seine fleet is having higher impact when compared to mechanized ring seine fleet except for Abiotic depletion potential elements (ADP elements) and Stratospheric ozone depletion potential (ODP), due to the high use of lead weight and polyamide webbing in mechanized fleets (Fig. 1a & b). Impact of motorized fleet Abiotic depletion potential fossil (ADP fossil), Acidification potential (AP), Eutrophication potential (EP), Global warming potential (GWP), Human toxicity potentials (HTP) and Photo-oxidant formation potential (POFP) shows more than 20% impact than mechanized fleet with a higher value of 24% in GWP.

The higher environmental impact of the motorized fleets are mainly due to the operational issues like the intensive use of kerosene as fuel by inefficient outboard engines, whereas mechanized ring seiners are propelled by inboard engines run by diesel. A similar study conducted in Norwegian fleet shows that 90 kg fuel was consumed per tonne of mackerel landed (Ramos *et al.*, 2011). Another in Galicia on the horse mackerel fishery reports that 176 kg of fuel has been used for the production of one tonne of fish. Studies on Spanish tuna fishery shows 420 kg of fuel usage per ton of production (Vázquez-Rowe *et al.*, 2010). There are no reported environmental impact studies based on CO_2 emission for any type of fishing method prevalent in the country.

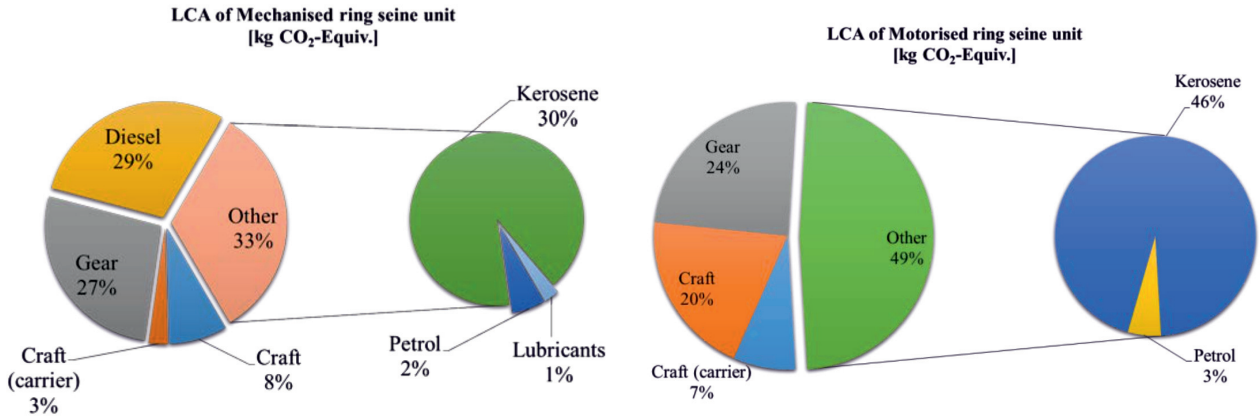

Fig. 1. Percentage contribution of a (a) mechanized and (b) motorized ring siene fishing system in operation to carbon emission

Through this study some important interventions can be proposed for the improved efficiency of this fishery like fishing vessel hull optimization, reduction of engine rpm, periodic maintenance of hull and replacement of two stroke petrol engine to inboard diesel engine in order to reduce environmental impact related to fishing operation and knowledge about pelagic fish spatial distribution to reduce the environmental impact by reduced shoal searching time. Use of high durability alternative webbing materials and appropriate use of lead sinkers will increase the life of gear and reduce the environmental impact.

References

ICAR-CMFRI (2016) - Marine Fish Landings in India-2015, Technical Report, ICAR-CMFRI, Kochi

Edwin, L. and Das, D.P.H. (2015) - Technological changes in ring seine fisheries of Kerala and management implications, ICAR-Central Institute of Fisheries Technology, Cochin, 104p.

Panicker, P.A. (1985) - An economic analysis of purse-seining from 13.25 m purse seines and form artisanal fishing craft 'thanguvala' along the Kerala coast. In: Harvest and post harvest technology, K. Ravindran (Ed.), ICAR-CIFT, Kochi P 113-119.

Ramos, S., Vázquez-Rowe,I., Iñaki Artetxe, Teresa Moreira, M., Gumersindo Feijoo and Jaime Zufía (2011) - Environmental assessment of the Atlantic mackerel (*Scombers combrus*) season in the Basque Country: Increasing the timeline delimitation in fishery LCA studies, *Intl J. Life Cycle Assess.*, **16:** 599.

SIFFS (1999) - A Census of Artisanal Marine Fishing Fleet of Kerala-1998, South Indian Federation of Fishermen Societies, Thiruvananthapuram, 132p.

Vázquez-Rowe, I. Teresa Moreira, M. and Gumersindo Feijoo (2010) - Life cycle assessment of horse mackerel fisheries in Galicia (NW Spain): Comparative analysis of two major fishing methods, *Fish. Res.*, **106(3):** 517–527.