

Boat fuel consumption by sea cucumber fishers: new study raises concern

Sea cucumber fishers can earn substantial incomes from harvesting these animals, but what is the environmental cost of their fuel consumption to access fishing grounds? A new study conducted in Fiji before the sea cucumber fishery closure shows that fishers were earning, on average, about USD 4000 per year from sea cucumbers. But their annual fuel consumption averaged more than 400 litres each, equating to around 8000 tonnes of greenhouse gases for all fishers across the fishery. Longer trips to access sea cucumbers on distant reefs and the use of scuba gears worsen the ecological footprint. The study's findings offer insights to managing sea cucumber fisheries at a critical time when Pacific Islands are campaigning for action on climate change.

Sea cucumber fisheries throughout the tropics are dominated by artisanal fishers using small boats and simple fishing gears. But does this mean that fishing is not lucrative, or that their collective use of fuel for outboard motors is insignificant?

A study from eight locations in Fiji was recently published in the *ICES Journal of Marine Science* and sheds new light on artisanal fishers (Purcell et al. 2018). Through funding from the Australian Centre for International Agricultural Research (ACIAR), the study interviewed 235 sea cucumber fishers in Fiji during 2014, before the cessation of exemptions on the use of scuba gears and before the eventual closure of the fishery.

Sea cucumbers are known to be a valuable resource for Pacific Island fishers, but few studies have actually presented data on their incomes. The recent study showed that fishing and selling sea cucumbers provided fishers with an average net income of FJD 8171 per year. Net income of women fishers was less than half of that of men, which is attributed to a range of factors. Apart from gendered variation in the net income of sea cucumber fishers, the study also showed that fishing income tended to decline with age of the fishers. Also, fishers with multiple income sources depended on sea cucumbers for a much lower proportion of their total income – so livelihood diversification should help fishers to reduce their dependency on the resource.

We gained data on fuel use by asking each fisher how much fuel they consumed on their last sea cucumber fishing trip, how many fishers shared that fuel cost and how often they went fishing. Fuel consumption differed greatly among sea cucumber fishers and locations. Nonetheless, the average fuel consumption to travel to and from fishing grounds was 428 L per fisher, per year. On average, sea cucumber fishers each spent FJD 3774 per year on boat fuel, which constitutes 28% of their average gross income.

We converted the fuel consumption to carbon emission equivalents using universal conversion rates for petrol. Estimates from experienced exporters indicated that there were around 8000 sea cucumber fishers in Fiji during the 2014–2016 period. Extrapolating the average carbon dioxide

(CO₂) emissions per fisher yielded an annual estimate of 8050 metric tonnes of CO₂ from boat fuel for the entire sea cucumber fishery. This estimate does not even take into account the carbon emissions from compressors to fill scuba tanks, wood and fuel used to cook sea cucumbers, and the land transport that is used to trade the products. The most striking finding was that this level of carbon emissions was



Village fishers in Fiji in a boat loaded with scuba tanks before heading off to distant fishing grounds in search of sea cucumbers (image: S.W. Purcell).

greater than many industrial fisheries throughout the world. The large 'ecological footprint' of Fiji's sea cucumber fishery is attributed to the fact that the thousands of fishers were making daily trips back and forth to fishing grounds in relatively fuel-inefficient boats.

We also found that men fishers had a greater fuel use compared with women fishers. Women fishers used 33% less fuel than men when collecting sea cucumbers via breath-hold diving because they tend to collect the animals at nearby sites. Women also tended to use gleaning (collection by walking on reef flats) more often than men and they were rarely engage in scuba diving. Therefore, female fishers were more economical than men, in terms of fuel usage.

Insights for fishery managers

The study's findings indicate that resource managers should promote and provide enabling environments for fishers in order for them to depend on a wide variety of livelihood sources. In doing so, fishers will be less dependent on the sea cucumber fishing and less likely to have to keep exploiting wild stocks when the populations are diminished.

The study also shows that some small-scale fisheries can be significant contributors of carbon emissions into the atmosphere. This means that even artisanal fisheries can have a large ecological footprint. The result is germane in current times, when Pacific Island governments are campaigning on the international stage for action on carbon emissions in order to reduce climate change impacts on rising sea levels and coral bleaching on reefs. So what can be done?

We suggested three potential responses by fishery managers:

1. Prohibit fishing methods that contribute greatly to carbon emissions. In sea cucumber fisheries, bans on the use of scuba gear and limits on using large boat motors would be strategies to consider.
2. Design fishery regulations and development initiatives in such a way to promote women in fisheries, since their fishing strategies tend to have a much lower ecological footprint than those of men.
3. Intervene with much more conservative fishing regulations much earlier, before wild stocks become too scarce. This will help to make fisheries more economical and avoid the scenario of fishers needing to travel far from villages in order to find reefs with decent stocks of sea cucumbers.



Women fishers on Taveuni, Fiji, with a bag full of sea cucumbers collected by way of snorkelling on a shallow reef flat near the village (image: S.W. Purcell).

Reference

- Purcell S.W., Lalavanua W., Cullis B.R. and Cocks N. 2018. Small-scale fishing income and fuel consumption: Fiji's artisanal sea cucumber fishery. *ICES Journal of Marine Science*. doi:10.1093/icesjms/fsy036.

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