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VARIABILITY IN FUEL EFFICIENCY OF A NORTH EAST ATLANTIC DEMERSAL TRAWL FISHERY

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ABSTRACT

The purpose of the study was to better understand the variability in fuel efficiency of a Norwegian freeze trawler targeting cod, haddock, saithe and shrimps, and to evaluate whether batch is actually a relevant resolution in LCAs and to increase the knowledge about the reasons behind variability. This was done by collecting daily data on fuel use and production for two years. Fishing trips targeting shrimps were shown to be significantly more fuel intensive than those targeting fish such as cod and saithe. Other actors explaining the difference between fishing trips were distance from port to fishing location, season, weather. Results can be used for internal improvement and as a basis for a simplified tool for environmental assessment.

INTRODUCTION

Life Cycle Assessment (LCA) has been identified as a useful, standardized approach to quantify environmental impacts in relation to a product from a supply chain perspective. A weakness is that LCAs are often resource intensive to undertake, which hampers operational day-to-day use and a drawback often pointed out by the industry is that results of different studies not fully comparable because of different goals and scopes. However, a finding common for many seafood LCAs is that on-board fuel use is often the single most important input in fisheries in current LCA calculations (Parker 2012, Vázquez-Rowe et al. 2012). Due to its large importance both from an environmental and economic point of view, and large variability both over time and between fisheries (Tyedmers 2001, Ramos et al, 2011, Vázquez-Rowe et al. 2012), depending on stock status, fishing gear and management regimes, it is important to understand more about the factors determining fuel efficiency to be able to increase it. While variability in fuel use between years has been shown to be extensive in the work cited, within-year variability has so far only been described by Almeida et al. (2013) and needs more attention. Decreasing the fuel use of the fishery is one of the most important steps in reducing the carbon footprint of the resulting seafood products. In a Seventh Framework EU project called WhiteFish, the aim is to meet this challenge by developing a simplified tool assessing the broad sustainability of North East Atlantic cod and haddock fisheries based on the LCA methodology. In the first phase of this project, detailed fuel and production data was collected for the fisheries involved, which is presented in this paper. In the second phase, full LCAs will be carried out, forming the basis for a simplified tool, which will be developed in the third and final project phase. The project addresses several of the drawbacks of traditional LCA stated above by providing a simplified tool for operational internal use within companies, by presenting a product specific standard and by increasing the resolution from year to batch. In this paper, the purpose was to better understand the variability in fuel efficiency by using a part of the data collected in the WhiteFish project to gain insight into the variability in fuel use of a Norwegian freeze trawler targeting cod, haddock, saithe and shrimps over time. In addition, to evaluate whether batch is actually a relevant resolution in Life Cycle Assessment modelling and to increase the knowledge about the reasons behind variability.

METHODS

In this paper, a Norwegian demersal trawler doing primary processing on-board, i.e. heading, gutting and freezing of the fish is studied to better understand the variability in fuel efficiency. The trawler mainly operates in the Norwegian Sea and Barents Sea, but also makes a few fishing trips to the North Sea every year. It mainly targets Atlantic cod, haddock, saithe (hereafter called fish) and northern shrimps. The functional unit is defined as one kilo of edible seafood at the point of landing with a fishing trip of four to 14 days being the batch. Multifunctional processes in the fish production chain are: the fishing stage, resulting in several species landed simultaneously, and fish processing, resulting in several edible co-products (e.g. fillet and mince) and non-edible co-products such as heads and guts (and in later processing stages also skin and bones). We chose to distribute the environmental burdens of the fishery on the co-products based on mass. Heads and guts are currently discarded at sea. In this short paper, we assume that the non-edible parts of the landings are not used further, meaning that edible products carry the full burden. To translate fuel use from total landing to edible seafood we used official Norwegian fillet yield factors, in lack of specific and batch-based data on this matter. The data analysed comprises two years of fishing (2011-2012) by the freeze trawler which makes around 20 fishing trips each year. Over 70 products are produced/landed every year, defined by the species, but also Marine Stewardship Council (MSC) or non-certified fish, several size categories per species as well as different product forms depending on the gutting method used. Fuel efficiency is measured as liters of diesel used per kilo of edible seafood landed and for comparison also in liters of diesel per kilo landed. We also studied an alternative indicator, perhaps more interesting from the fisherman’s point of view: Fuel efficiency per trip measured in liters of diesel used per economic landing value (kNOK). Fuel use per landing was analysed for the effect of year (2011 vs. 2012) and type of catch (fish vs. shrimps) and potential interactions between the two using an analysis of variance. Fuel use per edible yield and fuel use per landing value were analysed for the effect of type of catch only for the year 2011 using a Mann-Whitney U test.

RESULTS

The variability between trips within a year was large (Fig. 1). Trips 5, 6 and 14 targeted shrimps and were more fuel intensive than the other ones. The translation from total landing to edible yield did not change the ranking between trips, but reinforced the difference between trips targeting shrimps and fish, as the main fish species had a similar yield, while the yield of shrimps was lower. The same trips stand out as most fuel intensive per landing value, which is due to prices per kilo being surprisingly similar between the main species landed. Trips 1 and 13, targeting fish had a lower value of the landings. The target species in these trips was saithe, which is a lower value species than cod and haddock and the prices achieved were lower. The statistical analysis showed that the fuel use per landing was higher for trips targeting shrimps than for trips targeting shrimps ($P<0.001$). The interaction effect ($P<0.05$) between catch type and year showed year had a different effect on the trips targeting shrimps than on the trips targeting fish. Trips targeting shrimps had a higher fuel use per edible yield and fuel use per landing value than the trips targeting fish (both $P<0.01$).

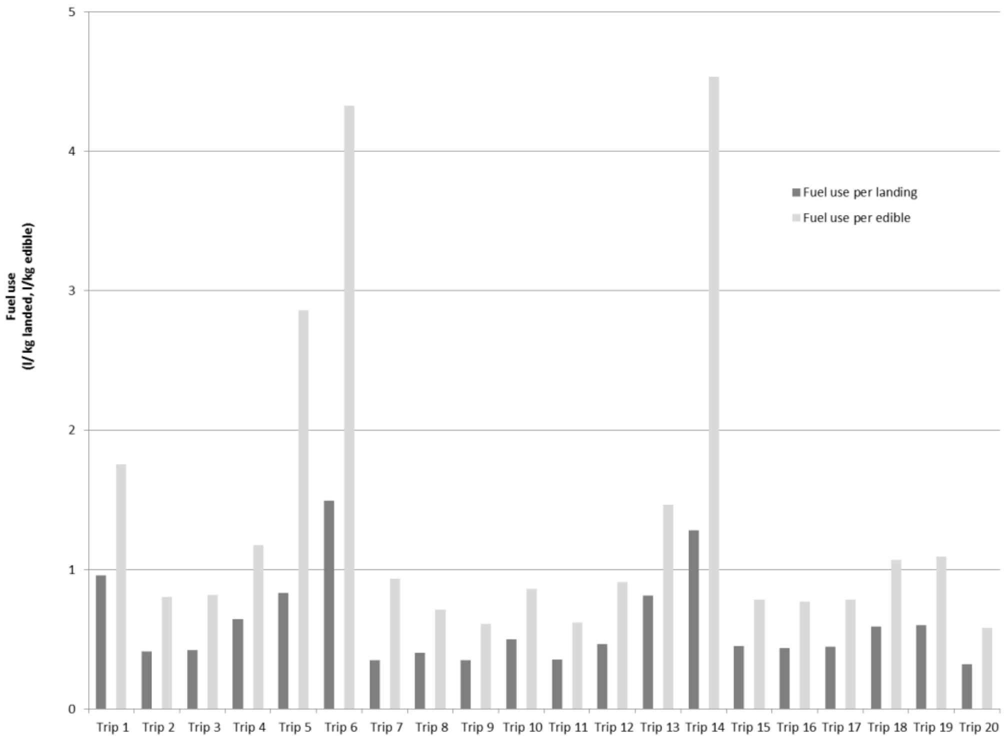

Figure 1. Fuel use in 2011 measured in liters of diesel per landing and per edible yield at landing.

DISCUSSION

The level of resolution of the data in this study gives new possibilities to look into details compared to previous studies. While variability over several years has been described recently in seafood LCA literature (Ramos et al. 2011, Vázquez-Rowe et al. 2012), considering variability within a year in the fuel efficiency of fisheries is a novelty in seafood LCAs and has so far only been described by Almeida et al. (2013). For some of the most fuel intensive fishing trips (In 2011: trips 5, 6 and 14 and in 2012: trips 4, 5, 12, 14 and 17) a common explanation was the target species being northern shrimps. Shrimp trawling is known to be more fuel intensive than fish trawling (Thrane 2004, 2006; Tyedmers 2001). Trawling for crustaceans has considerably lower Landings Per Unit of Effort (LPUE) values than fish trawling especially when using species-selective grids (Hornborg et al. 2012), as in this fishery. The LPUE seems to be the most important factor explaining the higher fuel intensity. It was harder to identify common characteristics of the fuel efficient trips, but due to the differences found between trips targeting fish and shrimps, using the annual average fuel use of the vessel (as is typically done in current seafood LCAs) would have over-estimated the fuel use of fish and underestimated that of shrimps in this case. Other potential factors explaining the fuel use, in addition of LPUE, are steaming time or distance from port to fishing location, weather, availability of quotas as well as strategic decisions taken by the skipper in each fishing trip. This vessel seems to fish most efficiently when targeting cod and haddock on the banks of the Norwegian, Greenland and Barents Seas. The fuel efficiency independently of how measured, ranks the trips in the same way, indicating that fuel efficiency in this fishery reflects both environmental and economic sustainability.

CONCLUSIONS

We showed substantial variability in environmental performance between fishing trips, mainly because of different LPUE when targeting different species and therefore this level of resolution (batch) is highly relevant to identify improvement options. In the fishery studied, the fuel efficiency depends mainly on the catch rate and it seems to be an indicator of both environmental and economic performance in this fishery.

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