

Environmental performance of wild-caught North Sea whitefish

A comparison with aquaculture and animal husbandry using LCA

May 3, Sander van den Burg



Introduction

- Difficult times for fisheries:
 - Increased competition from imports (aquaculture)
 - Image of the sector (overfishing, beam trawl)



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 - Increased competition from imports (aquaculture)
 - Image of the sector (overfishing, beam trawl)

- Can sustainability be a selling point?
 - Many claims on sustainability but,
 - Disputes on the question “What is sustainable?”
 - Lack of scientific data to compare environmental impacts

Objective

To make a scientifically sound comparison of the environmental impact of fisheries, aquaculture and animal husbandry.

Use of Life Cycle Assessment

- Generally accepted in environmental sciences
- Assess environmental impact of various stages
- Using uniform indicators
- Various tools such as SimaPro

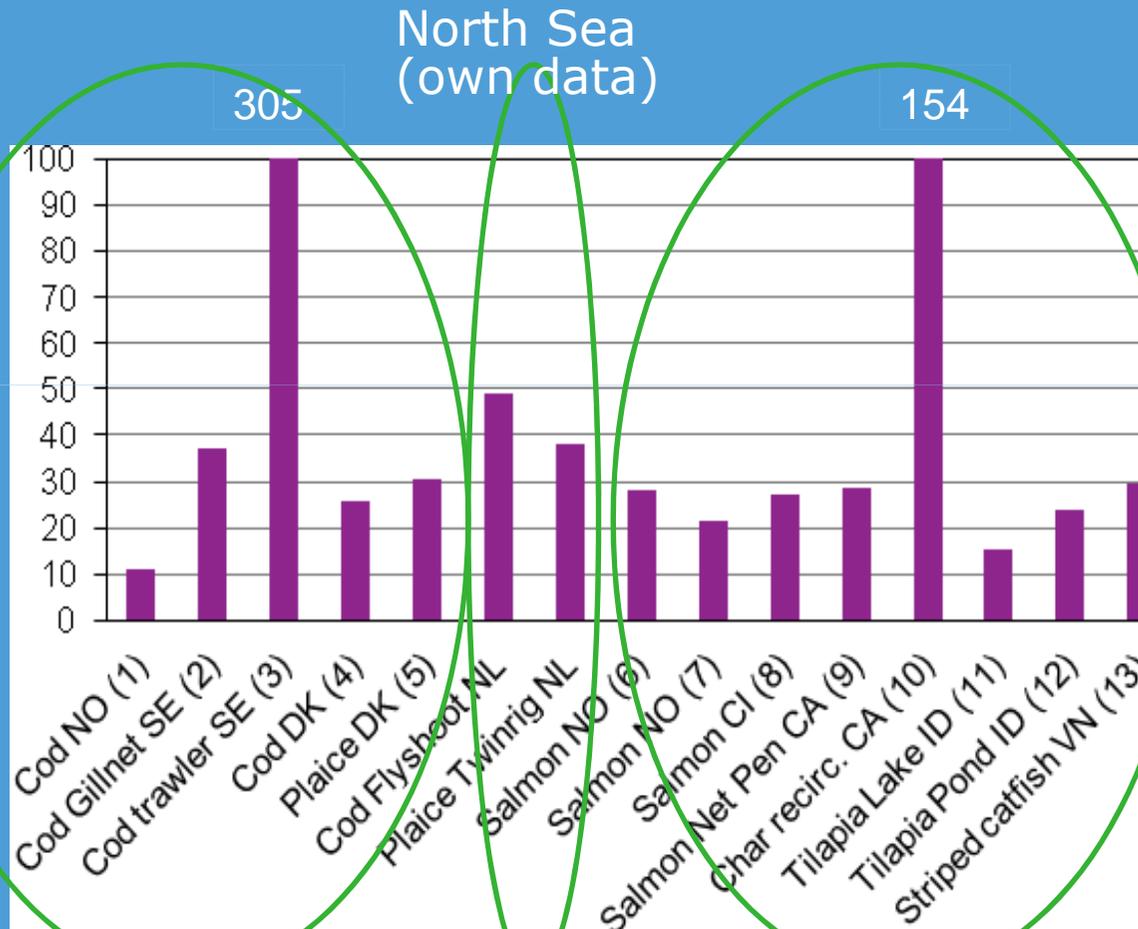
Methodology for the Life Cycle Assessment

- Deduction of technical parameters from peer-reviewed publications (2003 – 2011)
- Additional data from LEI sources (Fisheries Knowledge Networks, BIN)
- Factors from Ecoinvent v2.2
- Calculation of environmental impacts
- Different allocation methods make some comparisons impossible
- Not on all species information available
 - Wild-caught: plaice and cod
 - Aquaculture: Salmon, Tilapia, Pangasius

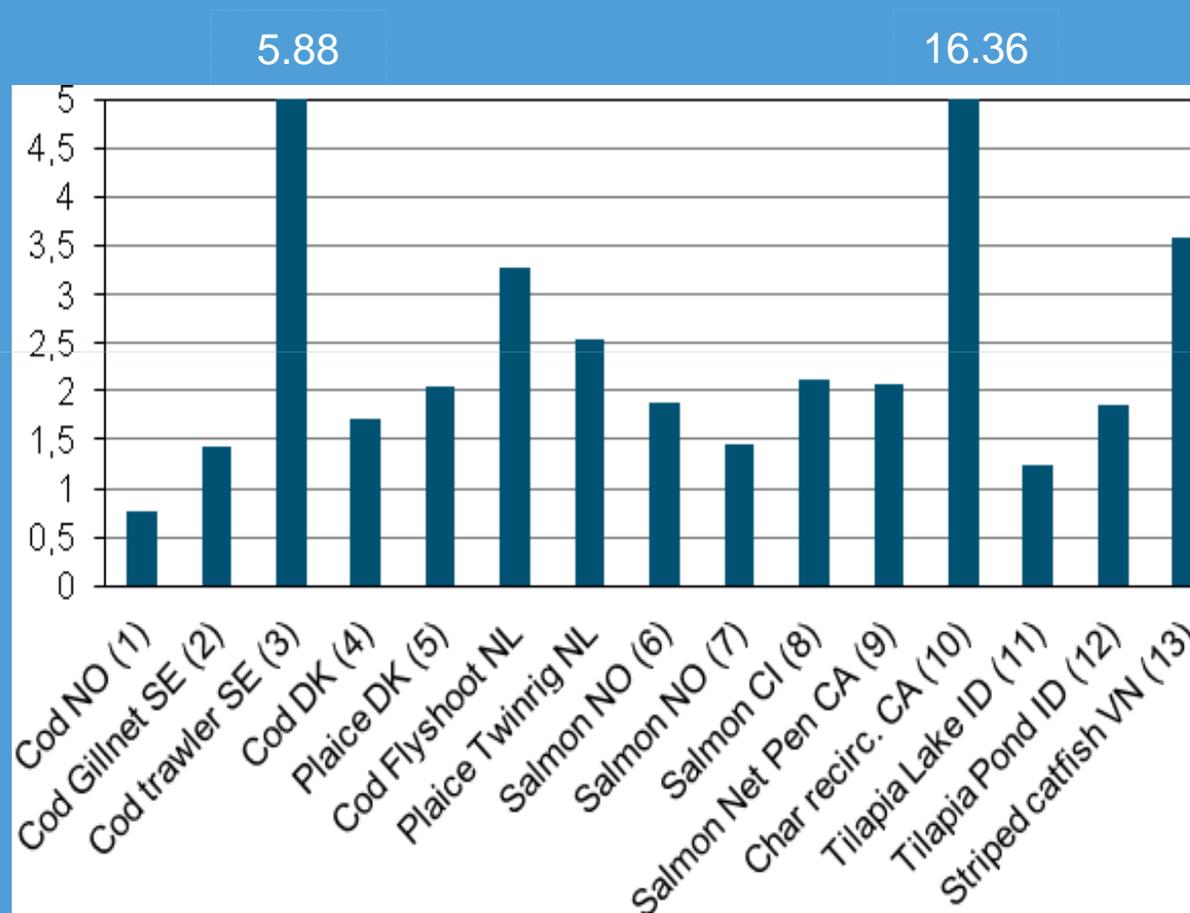
Total fossil energy use of analysed systems (in MJ/kg of fillet)

Fisheries (papers)

Aquaculture



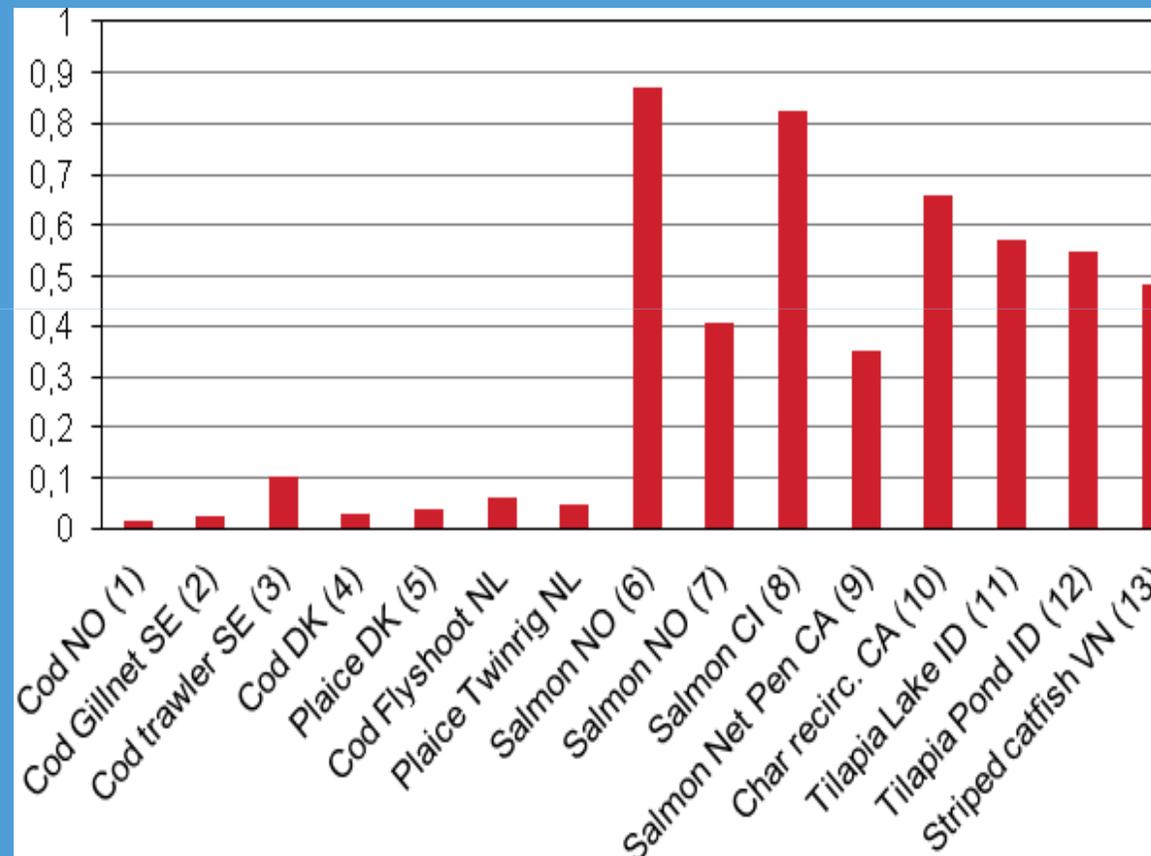
Global Warming Potential of analysed systems (kg of CO₂-eq/kg of fillet)



Energy use and Global Warming Potential

- Current LCA results do not show a significant difference ($p=0.80$) in energy use or global warming potential
- Difference in the mean values but there is a great deal of variance in the data, resulting in insignificance.
- The GWP of pangasius is strongly influenced by the amount of rice products included in the feed.
- Current estimates of the GWP of farmed salmon, tilapia and pangasius might be underestimated, because on-farm emissions of N_2O (greenhouse gas with a significant impact) are not included.

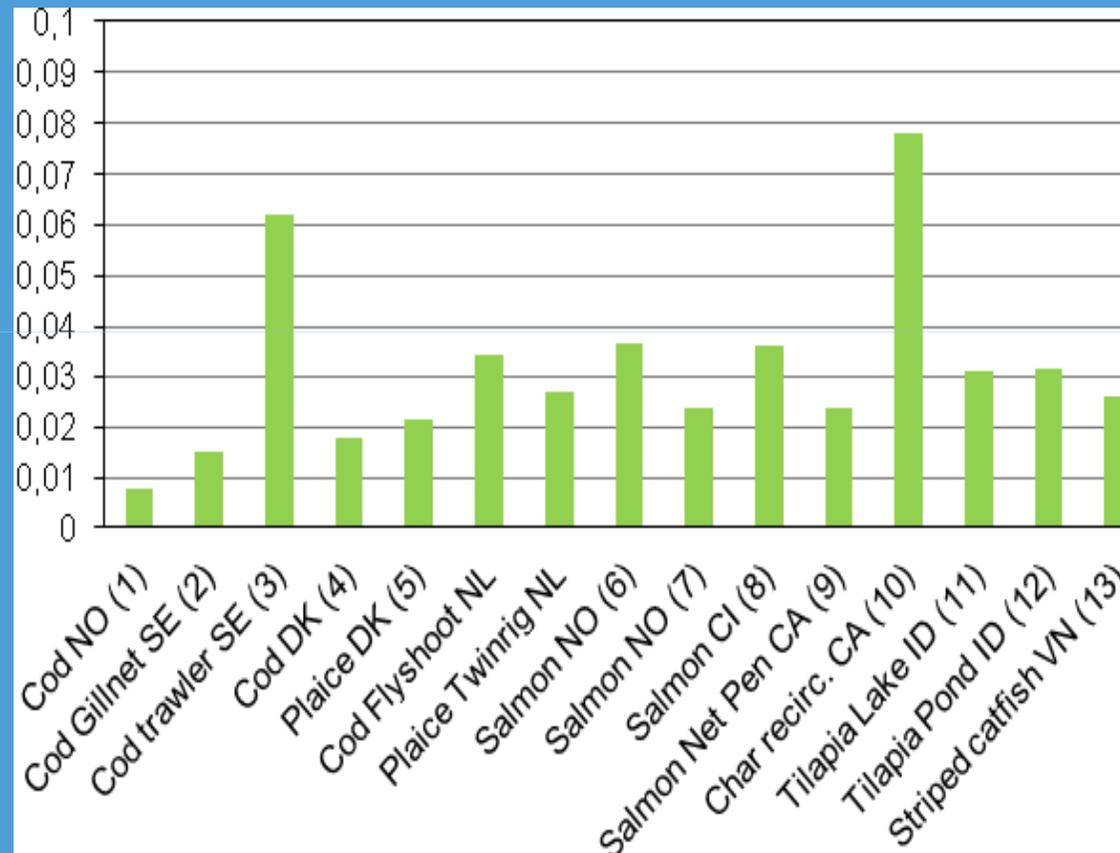
Eutrophication potential of analysed systems (kg of NO₃-eq/kg of fillet)



Eutrophication

- The eutrophication potential of wild-caught cod or plaice is lower than the eutrophication potential of farmed salmon or tilapia ($p < 0.0001$).

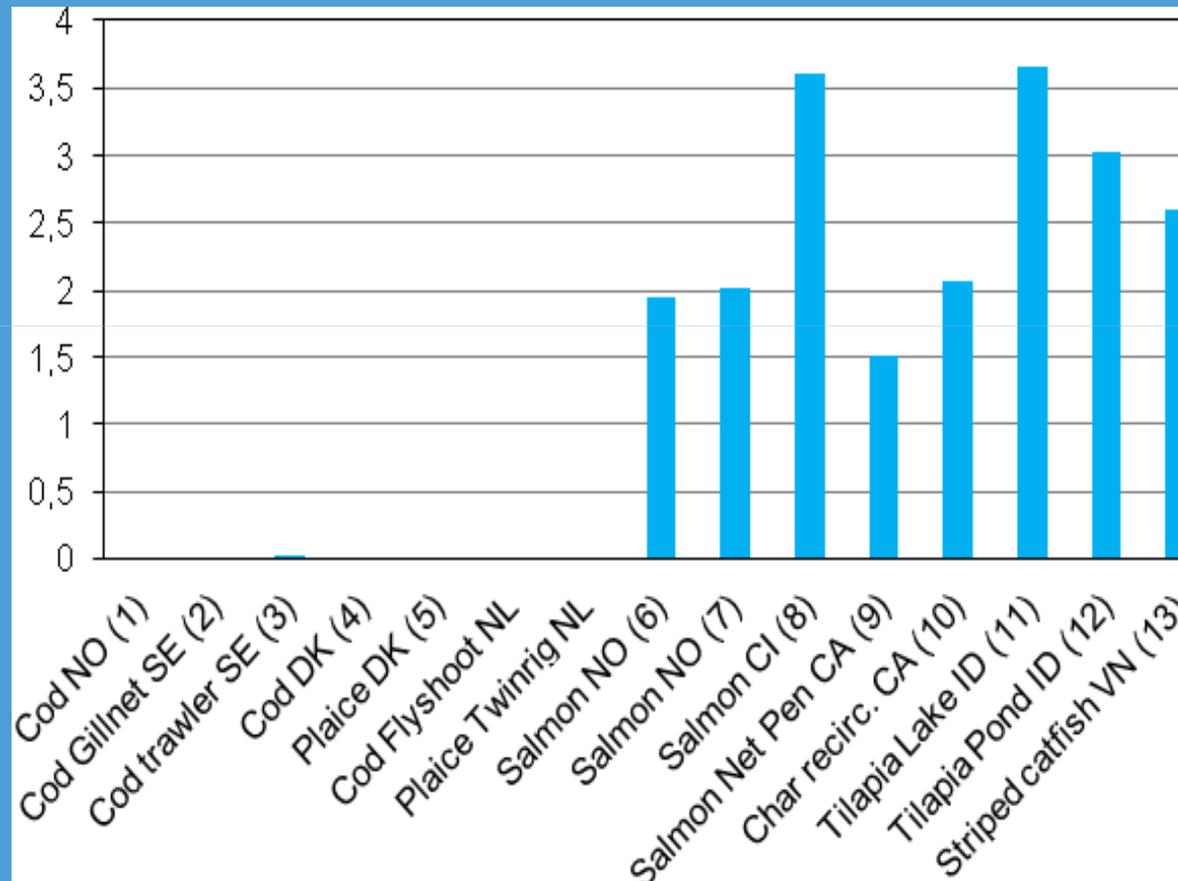
Acidification potential of analysed systems (kg of SO₂-eq/kg of fillet)



Acidification

- No significant difference in acidification potential per kg of wild-caught fish or fish from aquaculture ($p=0.33$).

Land use of analysed systems (m²/kg of fillet)



Land use

- The land use is significantly higher in aquaculture ($p < 0.0001$).
- The land use for fisheries only includes land used for the extraction and production of energy.
- Wild-caught fishing often has an impact on the ecosystems in the sea. It is difficult to quantify this and weigh it against other impact categories (Thrane, 2004).

Results, comparing wild-caught and animal husbandry

- Only comparison for energy use and global warming potential (due to differing allocation methods)
- Only for Dutch fisheries

Comparing energy use and GWP of plaice, cod, pork, chicken and beef

	Energy	GWP
Cod flyshoot NL	106	7.2
Plaice twinrig NL	91	6
Pork	18-45	3.9-10
Chicken	15-29	3.7-6.9
Beef	34-52	14-32

Results, comparing wild-caught and animal husbandry

- The energy use for plaice and cod is higher than the energy use for pork, chicken or beef.
- The global warming potential of plaice and cod is in the same range as that of pork and chicken.
- Beef has a higher GWP, explained by the non-CO₂ greenhouse gas emissions from animals and manure.

Improving performance of fisheries and aquaculture

- Many development
 - Increasing fish stocks
 - Better fuel efficiency
 - Alternative fuels
 - Plant based
 - Fish-based
 - Improved FCR
 - Alternative feed sources
 - Plant based
 - Fish-based

Improving performance of fisheries and aquaculture

Summary of effects on outcome of LCA							
		Energy use	GWP	EP	AP	Land use	
Wild-caught	Increased fish stock	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	Reduced fuel consumption	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	Alternative fuels	Plant-based	=	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Fish-based	=	<input type="checkbox"/>	=	=	
Aqua-culture	Improved FCR	<input type="checkbox"/>					
	Alternative feed sources	Plant-based	<input type="checkbox"/>				
		Fish-based	<input type="checkbox"/>				

Conclusions

- Good possibilities to reduce environmental impact of fisheries and aquaculture.
- All technologies that reduce fuel use have a direct positive impact on the LCA.
- Other changes, such as a shift to biofuels or changes in the diet of aquaculture, all come with pros and cons.

Conclusions

- Current LCA results do not show a significant difference ($p=0.80$) in energy use or global warming potential
- Difference in the mean values but there is a great deal of variance in the data, resulting in insignificance.
- Energy use of fisheries is higher than for meat but GWP is comparable, except for beef
- The eutrophication potential of wild-caught cod or plaice is lower than the eutrophication potential of farmed salmon, tilapia or pangasius ($p<0.0001$).
- No significant difference in acidification potential per kg of wild-caught or farmed salmon, tilapia or pangasius ($p=0.33$).
- The land use is significantly higher in aquaculture ($p<0.0001$).

Discussion

- No proper information on sole available.
- An integrated comparison of the environmental impact of plaice, cod, salmon, tilapia and pangasius also requires insight into the impact on ecosystems.
- Currently, there is no suitable information available for including such impact in the LCA.
- Under current conditions, the life cycle assessment does not include the energy used while building the vessel.
- It was not possible to collect more information on the acidification and eutrophication potential of pork and chicken.

Thanks for your attention

For draft paper, please
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