How to decrease farmed fish environmental burdens through feed formulation and feeding management

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Introduction

This paper focuses on the quantification of improvements in farmed fish (European seabass Dicentrarchus labrax and gilthead seabream Sparus aurata) environmental burdens resulting from the application of latest know-how in feed formulation and feeding management. Environmental burdens from the whole aquaculture production chain were assessed according to the life cycle assessment (LCA) methodology in order to identify critical areas and the best solutions to improve them.

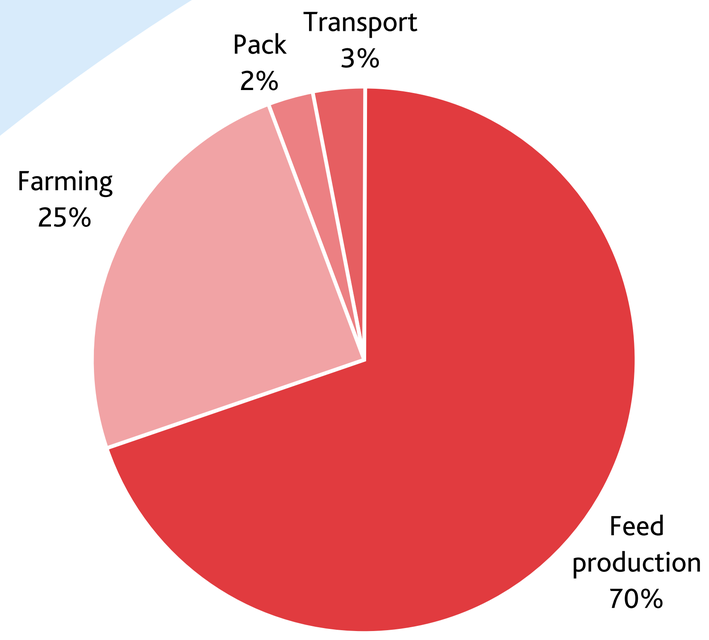
Materials & Methods

The Life Cycle Assessment was performed following the international standards ISO 14040 series (EN ISO, 2006).
The indicator evaluated is the GWP100 (Global Warming Potential). The characterisation factors of GWP100 come from IPCC 2007 (Forster et al., 2007). The SimaPro 7.1.8 software application and the Ecoinvent 2.01 (2007) database were used in this study to implement the LCA model and carry out the assessment. The LCA was performed per 1 kg of farmed fresh fish considering the whole production chain from hatchery to fresh fish distribution platform (including the raw materials used for feed production).
Primary data on raw materials production, farming and packaging are referred to year 2009

PHASE	DESCRIPTION
Feed production	This phase considers: Raw materials cultivation and fish oil and fish meal production (used for feed)Feed production (different type of formulas are considered, one formula equal for both sea bass and sea bream is used in the model).
Farming	Energy and water consumption and waste production related to farming are considered in the model. Hatchery is not considered.
Packaging	Packaging (mainly polypropylene box) production used for fish transport is considered.
Transport to Distribution Platform	Fish transports from farming to distribution platform are considered. All transports are cooled and so the environmental aspects have been increased of about 10%

Results and Discussion

Main contributions to GHG emissions are given by feed production and farming, as showed in Figure 1. Feed environmental burdens depends mainly on raw materials cultivation used in formulations and Feed Conversion Ratio (FCR), which indicates how much feed is needed per kg of weight gain. As showed in figure 2 FCR is directly linked to environmental burdens. Farming environmental burdens are mainly related to energy consumptions. One of the most efficient strategy to reduce environmental impacts is FCR improvement (through the use of nutritionally balanced formulations and careful feeding management) together with flexible use of raw materials. Improved FCR, together with advanced nutritional know-how and freedom in raw materials choice, results in reduced fish meal and fish oil consumption in farmed fish production, hence alleviating pressure on wild fish stocks.



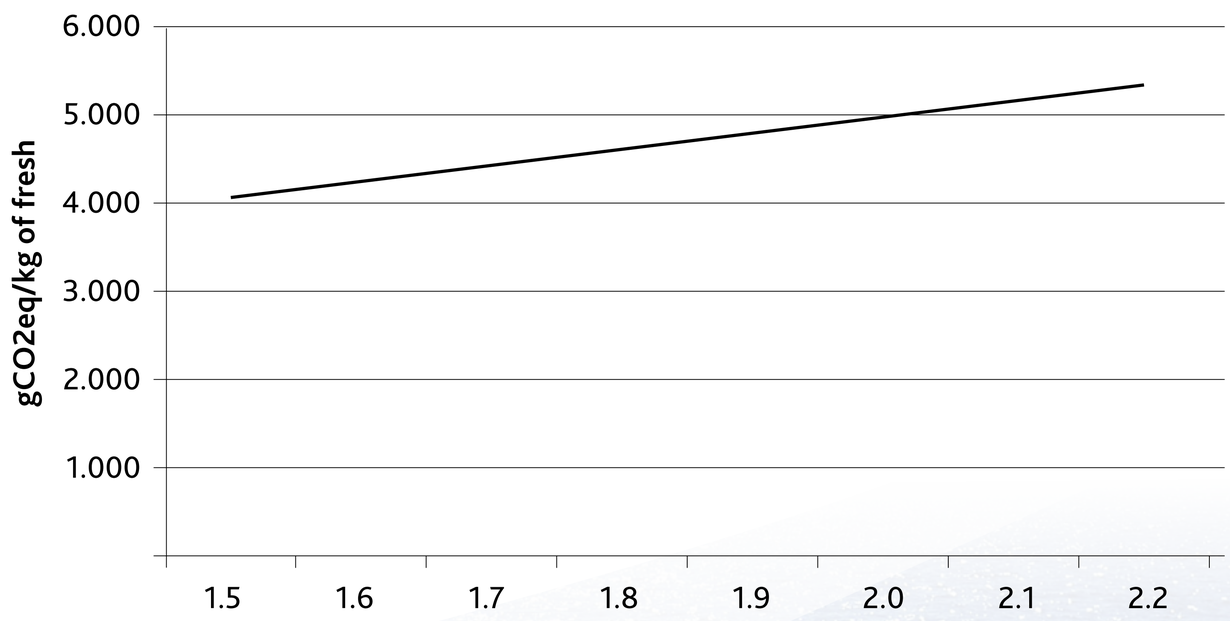


Figure 1:
Contributions of the single phase of the Life Cycle Assessment to the greenhouse gases emissions

Figure 2:
Direct correlation between the FCR and the GHG emissions

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Feed Conversion Ratio (FCR)

The ratio of the gain in the wet body weight of the fish to the amount of feed fed The true F.C.R includes wasted feed and mortalities.
The ratio, usually expressed as a true ratio (i.e. 1 : 1.5) is often quoted as a "rate" (1.5). Feed conversion ratios of less than 1 : 1 are possible with commercial diets, as the pellet being fed is a "dry" diet, and a high percentage of weight gained by the fish, is water trapped in the tissues and cells. Feed conversion ratios with commercial "dry" diets are typically in the region of 1 : 0.8 to 1 : 1.5.