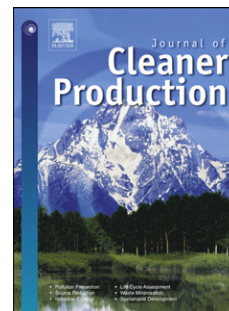


# Accepted Manuscript

Resource use analysis of *Pangasius* aquaculture in the Mekong Delta in Vietnam using Exergetic Life Cycle Assessment

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1 **Resource use analysis of *Pangasius* aquaculture in the Mekong Delta in**  
2 **Vietnam using Exergetic Life Cycle Assessment**

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13 **Abstract**

14 Depletion of marine fish stocks has become a global problem. Aquaculture is seen by many as the  
15 best way to meet the growing demand for fish products. The question then arises whether  
16 aquaculture is a truly environmentally sustainable alternative. Every type of aquaculture is different,  
17 therefore each one merits its own case study. To date, Life Cycle Assessment (LCA) studies have  
18 mainly examined Western culture systems, although Asia predominates the world aquaculture  
19 production by quantity. In this research, we focus on a vertically integrated Vietnamese top exporter  
20 of *Pangasius* food products in the Mekong Delta. Along with a tremendous expansion of this sector in  
21 recent decades, intensification coincided with an increased material and energy demand. Therefore,  
22 we focus on resource extraction (from cradle to farm gate), expressed as the Cumulative Exergy  
23 Extraction from the Natural Environment (CEENE). Hot spots in resource demand are identified over  
24 the life cycle stages (juvenile production, feed production and culturing to marketable-sized fish). The  
25 life cycle resource footprint includes mainly land (62%, mainly for feed production), water (31%,  
26 mainly for on-site farming of the fish) and fossil fuels (4%, mainly for energy needs throughout the  
27 feed supply chain). Main methods for reducing this resource demand should be lowering the feed  
28 and water input into the ponds and improving the efficiency of the feed supply chain. Pros and cons  
29 of closed-loop water-saving systems are discussed. The feed supply chain plays a key role in  
30 improving the resource use efficiency. Vietnamese *Pangasius* producers should be introduced to life  
31 cycle thinking and encouraged to pay attention to the environmental performance of their suppliers  
32 across the world. For the last goal, a new metric system to score the Feed Conversion Ratio (FCR), i.e.  
33 the CEENE FCR, is introduced here.

34 **Keywords** Life Cycle Assessment, resource footprint, CEENE, *Pangasius*, aquaculture, Vietnam

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