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## Environmental performance of the poultry meat chain – LCA approach

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### Abstract

This review aims to give an overview of published environmental assessments using the life cycle assessment (LCA) approach. LCA was deployed in terms of five main subsystems in the poultry meat chain: poultry farm, slaughterhouse, meat processing plant, retail and household use. This review revealed that 15 different environmental potentials are used as environmental indicators for estimating environmental performance of the poultry meat chain. General finding is that further research should use the LCA approach to assess the environmental performance of an overall poultry meat chain, focusing on the global warming potential, acidification potential, eutrophication potential and ozone layer depletion.

*Keywords:* life-cycle assessment; poultry meat chain; environmental potentials

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### 1. Introduction

The environmental impact of livestock production has a major impact on the environment, since meat contributes between 4.6 and 7.1 gigatonnes of greenhouse gases (GHG) each year to the atmosphere and production processes for meat account for between 15% and 24% GHG emissions<sup>1</sup>. The environmental impact of poultry chain is estimated to emit 0.6 gigatonnes CO<sub>2</sub>-equivalent<sup>2</sup>.

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According to ISO 14040, life-cycle assessment (LCA) represents the compilation and evaluation of the inputs, outputs and potential environmental impacts of a product system throughout its life cycle and it is a tool for the analysis of the environmental burden of products at all stages in their life cycle<sup>3</sup>. A limited number of studies have researched environmental performance in the meat chain, especially the poultry chain. There are papers targeting different aspects of the poultry meat chain, but there is an evident lack of studies concerning life-cycle assessment (LCA) approach for the environmental performance of an overall poultry meat chain. Table 1 gives an overview of the poultry chain LCA manuscripts emphasizing system boundaries and environmental impacts.

Table 1. Summary of studies linking environmental impacts of the poultry chain.

Authors	Sample	Research focus	System boundaries <sup>a</sup>					Environmental impact <sup>b</sup>
			1	2	3	4	5	
[4]	3 main broiler production systems in the UK	LCA of broiler production systems			✓			GWP, EP, AP, EC, LC, ADP
[5]	Two production scenarios of chickens	Comparison of production of chickens consumed in France	✓	✓	✓			GWP, CED, AP, EP, TEP, EC, LC
[6]	Chicken product	Environmental improvement through LCA methodology	✓	✓	✓	✓	✓	GWP, OLD, AP, EP, WC, CED
[7]	Chicken meat production systems in Switzerland	Environment impacts and selected import sources	✓				✓	CED, GWP, OLD, LC, AP, EP, TEP, HT, WC, FEP
[8]	Poultry slaughterhouse in Brazil	A case study of cleaner production		✓				WC, EP, FD
[9]	Two chicken meals	Life cycle assessment of integrated food chains – Sweden					✓	GWP, AP, EP, POFP
[10]	The US broiler poultry sector	Life cycle energy use and greenhouse gas, ozone depleting, acidifying and eutrophying emissions	✓	✓	✓			GWP, OLD, AP, EP, EC
[11]	Two differing Brazilian poultry production systems	Cradle to gate study	✓	✓	✓	✓		GWP, OLD, AP, EP
[12]	Finnish broiler chicken fillet product	Supply chain integrated LCA method	✓	✓	✓	✓		GWP, AP, EP, OLD, PS, FEP
[13]	Meat production	An estimation of potential future greenhouse gas emissions			✓			GWP

<sup>a</sup>: Subsystem 1 — Poultry farm; Subsystem 2 – Slaughterhouse; Subsystem 3 – Meat processing plant; Subsystem 4 - Retail; Subsystem 5 - House hold use;

<sup>b</sup>: Global warming potential (GWP); acidification potential (AP); eutrophication potential (EP), ozone layer depletion (OLD), photochemical smog (PS) and human toxicity (HT); abiotic depletion potential (ADP); land competition / use (LC); photochemical oxidants formation (POFP); energy consumption (EC); water consumption (WC); cumulative non-renewable fossil and nuclear energy demand (CED), terrestrial ecotoxicity (TEP), Freshwater depletion (FD), fresh water aquatic ecotoxicity (FEP)

## 2. Life-cycle assessment

LCA is a tool used for identifying hot spots in the production chain which may give opportunities for lowering environmental impacts while improving efficiency and profitability<sup>14,15</sup>. Analysis of Table 1 shows that common potentials analyzed by all authors for subsystem 1 are GWP, AP and EP, for subsystem 2 is EP, for subsystem 3 is GWP, for subsystem 4 are GWP, AP, EP and OLD and for subsystem 5 are GWP, AP and EP.

The system boundaries cover five main subsystems ‘poultry farm’, ‘slaughterhouse’, ‘meat processing plant’, ‘retail’ and ‘household use’. The ‘waste and waste water’ subsystem is present in each of the five subsystems, which includes all activities related to waste management of solid waste and treatment of waste water.

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