

Environmental sustainability of the European broiler meat

Extrinsic quality is that part of quality that deals with how a product is produced, i.e. the quality of its production system.

This part of the ONE quality concept is increasingly requested by consumers and policymakers, in order to obtain high-quality products, in particular animal-sourced food, in high-quality systems.

Among the different aspects of the extrinsic quality, the environmental sustainability is one of the cited in the last years, the animal production having been found connected with different negative and positive impacts on natural ecosystems

intaqt
one quality

In the last decades, the innovations and investments in inputs such as genetics, rearing structure, management practices and technological tools in broiler production have allowed notable increases in both productivity outputs and production efficiency, but at the same time increasing concerns about environmental sustainability have been observed.

Previous studies have explored the relationship between intensity level in animal production and environmental impact (EI), finding complex associations with the type of impact assessed (Salou et al., 2017; Bava et al., 2018), how the increase in the input intensity is performed (O'Brien et al., 2016) or the interaction between genotype and diet (Huerta et al., 2025). Thus, analysing EIs across a gradient of intensification may therefore help identifying whether intensification produces consistent improvements or whether provide a more informative approach than comparing discrete production systems, allowing potential trade-offs and non-linear responses emerged.



The aim was to assess the EIs associated with European broiler meat production in different production systems classified along a gradient of intensification using a multi-category Life Cycle Assessment (LCA) approach. Following the LCA standards (ISO, 2006; FAO LEAP, 2014), the assessment was based on attributional LCA with a cradle-to-farm gate system boundary (i.e. from the placement of chicks on the farm until birds left the farm for slaughter).

Considering 1 kg bodyweight as functional unit, data originated from 82 broiler farms located Belgium, France, Italy, Poland, Switzerland. Data on housing, animal performance, manure handling, feeding management and farm materials were collected. impacts were calculated using the FarmLCA tool (Moakes et al., 2026), considering climate change (CC), CC plus land use change emissions (CC_LUC), terrestrial acidification (TAP), freshwater and marine eutrophication (FEP, MEP), fossil and non-renewable energy use (FNEU), land occupation (LO) and freshwater ecotoxicity (FWeco).

Farms were grouped in 6 classes according to housing and genotype: outdoor systems using slow-growing (Out_Slow), medium-growing (Out_Med) or fast-growing (Out_Fast) genotypes, and indoor systems using fast-medium-growing (Ind_Fast-med), fast-growing genotypes for standard production (Ind_Fast) or for heavy broiler production (Ind_Fast_H).

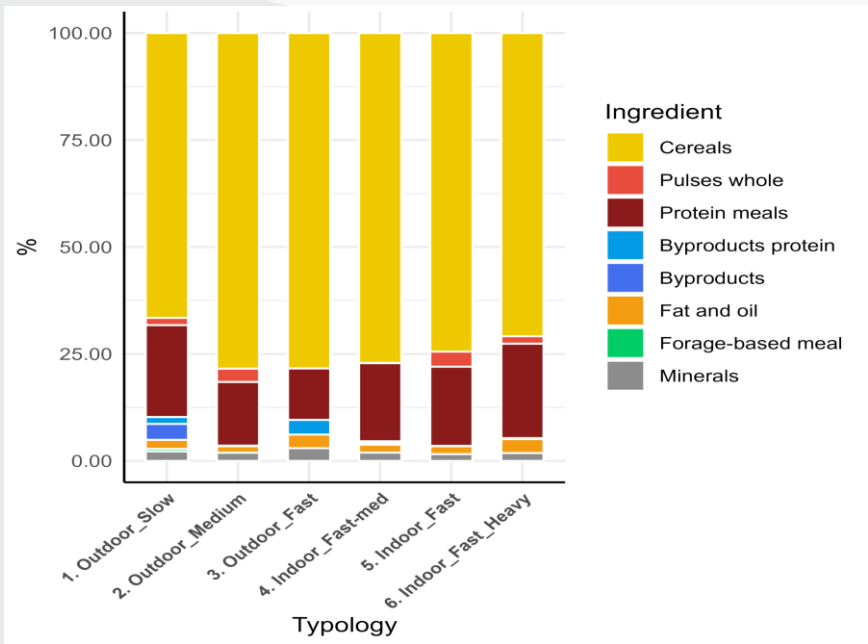


Fig 1: Diet composition, per intensification class (%)

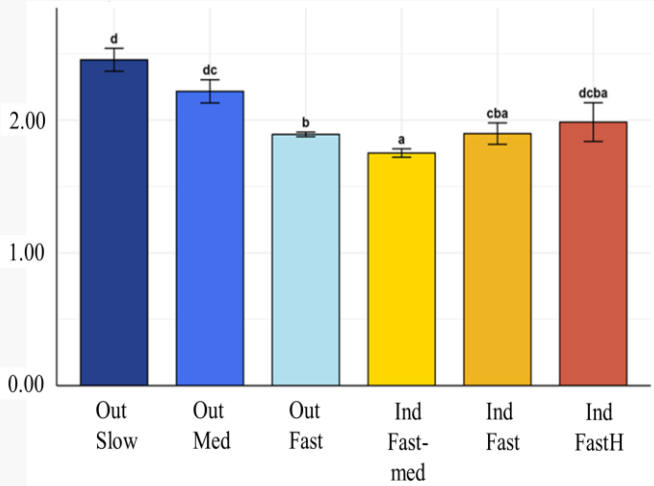


Fig 1: Climate change results, per 1 kg bodyweight, per intensification class (different letters refer to statical difference)

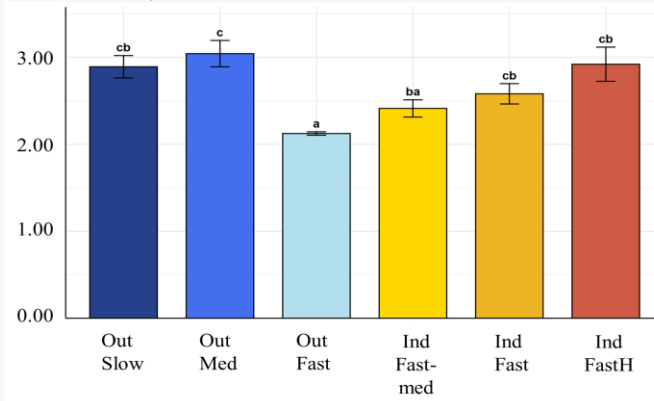


Fig 1: Climate change plus land use change results, per 1 kg bodyweight, per intensification class (different letters refer to statical difference)

Life Cycle Assessment aims to assess the environmental impact (EI) of a product considering its different life cycle, from the production of the raw materials to the end-use disposal. In animal systems, it is widely used to track, assess and minimize EI.

Across the 82 farms, the average batch size was 71,216 broilers per cycle, with high variability among farms (standard deviation (SD): 109,620). After a cycle of 56 days (SD: 20) on average, mean final body weight (BW) was 2.37 kg/head (SD: 0.58). Average daily weight gain (ADG) was 45.5 g BW/head/day (SD = 15.6) and the mortality rate averaged 2.9% (SD: 1.9). During the fattening cycle, the daily feed intake per head averaged 81 g (SD: 19) and the total feed intake was nearly 4.4 kg (SD: 1.5). Considering this and the related BW increment, the resulting feed conversion ratio (FCR) resulted, 2.23 kg feed/kg BW gain on average (SD = 0.67). The diet had an average crude protein content of 18.8% (SD = 1.73), composed mainly by maize flour, wheat flour, and soybean meal, which accounted on average for 41%, 27%, and 16% of the diet, respectively (used in all the farms). The remaining ingredients (average presence < 3.4%) comprised alternative cereal flours (barley, oat), protein-rich sources (sunflower, rapeseed and pea), soy and sunflower oils and byproducts such as wheat bran or maize middling.

A main LCA output is the how much each production stage contributes to the various impacts. Here, the feedstuffs resulted the main contributor across all impact categories (from 64% for MRU to 96% for LO), except for TAP and MEP (37-38%). In these two last categories, the manure management had a major role (41% for TAP and 48% for MEP). (Fig. 3)

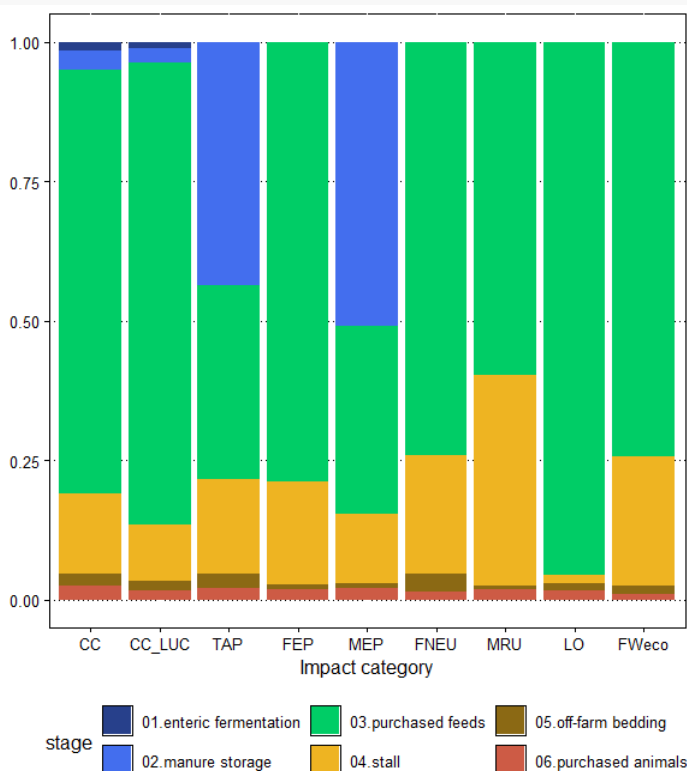


Fig 3 Hotspot analysis per impact category climate change (CC), CC plus land use change emissions (CC_LUC), terrestrial acidification (TAP), freshwater and marine eutrophication (FEP, MEP), fossil and non-renewable energy use (FNEU), land occupation (LO) and freshwater ecotoxicity (FWeco). Values in %

Intensification class significantly affected all animal performance and management traits analyzed. Moving across the intensification gradient, we observed a decline in the duration cycle (85→35 d) and FCR (3.2→1.69 g/head/d), an increase in ADG (24→63 g/head/d) but also in mortality rate (up to 4%).

Likewise, intensification class significantly affected impact values. The general trend was of a reduction in impact value while increasing the intensity level. Indoor systems obtained average impacts 5%-56% lower than outdoor ones, excepted for CC_LUC, but notable variation was found within indoor and outdoor systems. In addition, the minimum impact values were found for classes intermediate in the intensification gradient (Out_Fast, Ind_Fast-med, Ind_Fast, depending on impact categories). This could be related to declining marginal gains in terms of ADG and FCR (more output per unit of input) and at the same time potential trade-offs in animal status (e.g. mortality) or in feed impact cost at the highest intensity levels,

The results of this study show the complexity of the relationship among input intensity, animal response and associated LCA-based impacts. Overall, the results indicated a positive association between intensity level and impacts per BW unit. At the same time, this relationship could have specific characteristics depending on the impact category evaluated. Moreover, the reduction in the mitigation capacity of additional input investments highlights the need to explore new practices or to combine practices from different farm typologies in order to pursue the best farm settings in each context. On the other hand, the variability observed within each system represents a space for improvements with present-day practices. In perspective, the results could be used by farmers, policymakers and other stakeholders to build innovative practices and tools for increasing the environmental sustainability of European broiler production, while considering other sustainability dimensions such as animal welfare or economic viability.

Environmental sustainability is one of the different pillars of sustainability associated with anthropic systems, together with economic and social sustainability. On this issue, an important role in animal production is the animal welfare. Within the INTAQT project, the extrinsic quality of broiler meat quality was evaluated not only in terms of environmental impact but also of animal welfare, in the pursuit of animal systems that can produce high-quality products, with minimum impact on natural ecosystems and optimal level of animal health and welfare.

