

Livestock farming intensification: mitigating or exacerbating feed-food competition?

Contrasting results in broiler, dairy and beef production

Feed-food competition arises when livestock consume feed and use land that could otherwise serve human nutrition directly. Livestock consumes about 6 billion tonnes of feed per year and uses about 50% of the global agricultural land; although 86% of this feed is inedible to humans, livestock still uses 31% and 76% of the global production of cereal and soy.

Feed-food competition could be minimised in two contrasting ways. First, by improving feed conversion efficiency through intensification: higher productivity per animal reduces the land required per unit of output, thereby freeing land to produce more food. Second, by prioritising non-human-edible resources: ruminants can convert grass and other inedible feeds into human-edible food, and extensive grass-based systems may even become net producers of human-edible protein, though at the cost of lower animal productivity. Intensification thus plays an ambivalent role, either mitigating or exacerbating feed-food competition.

The INTAQT project investigated the relationships between livestock intensification and feed-food competition in broiler and cattle farming systems from nine European countries.

Results showed that Intensification improves productivity and gross feed and land use efficiency, but gains plateau for high-input systems. When only human-edible feed and arable land are considered, intensification reduces feed-food competition in broilers, but exacerbates it in cattle where strict grass-based systems remain net producers of human-edible protein.

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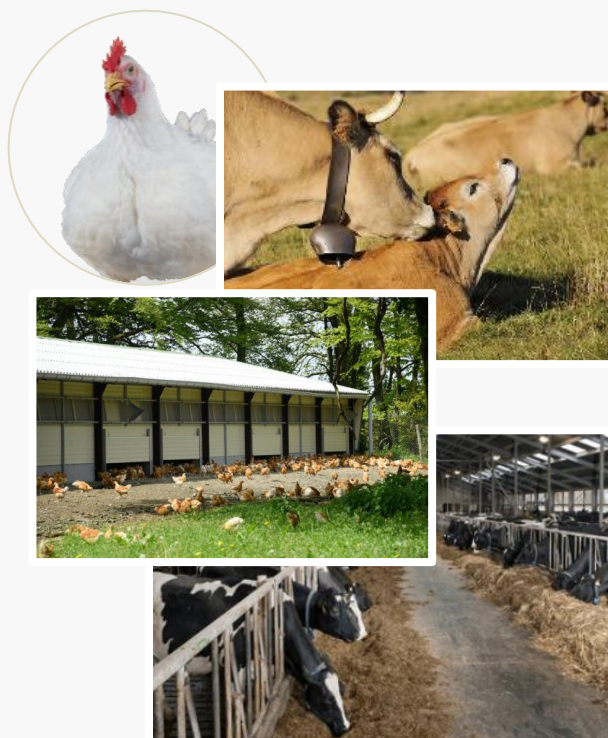


Fig 1: Illustration of the diversity of broilers and cattle production systems

To understand the effect of livestock farming intensification on feed-food competition, we established a network of 209 commercial farms producing chicken (79), cow milk (77) or beef (53), selected across 9 European countries (Fig 2) and a wide range of systems: conventional, organic, PDO and niche systems. During farm visits, structured interviews characterised farm structure, practices and feeding strategies, and protein content was measured on milk and meat samples from each farm.

Intensification improves gross performance... up to a plateau

Productivity increased with intensification in all three productions. Land productivity was highest in broilers (≈330 kg protein/ha), intermediate in dairy (≈220 kg/ha) and lowest in beef (≈80 kg/ha), rising with inputs within each product, but reaching plateaus for the most intensive systems.

Gross protein feed efficiency improved with intensification, up to clear plateaus (Table 1)

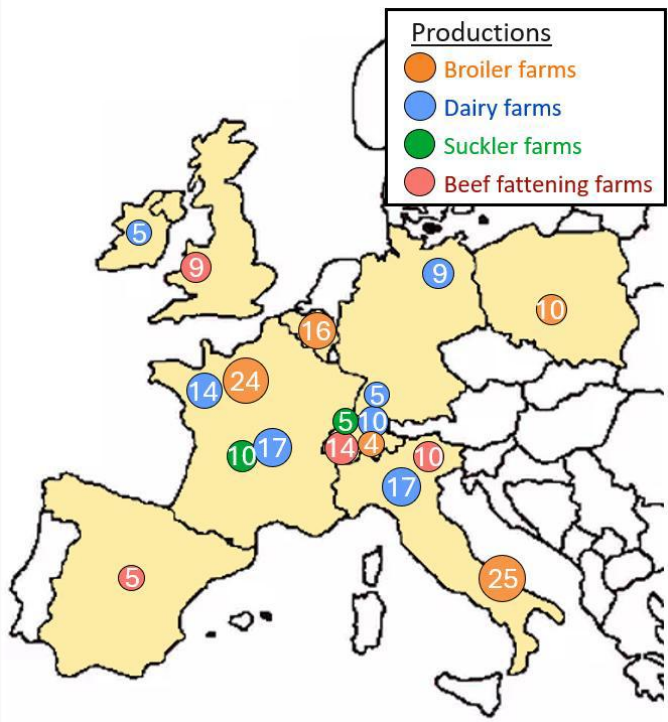
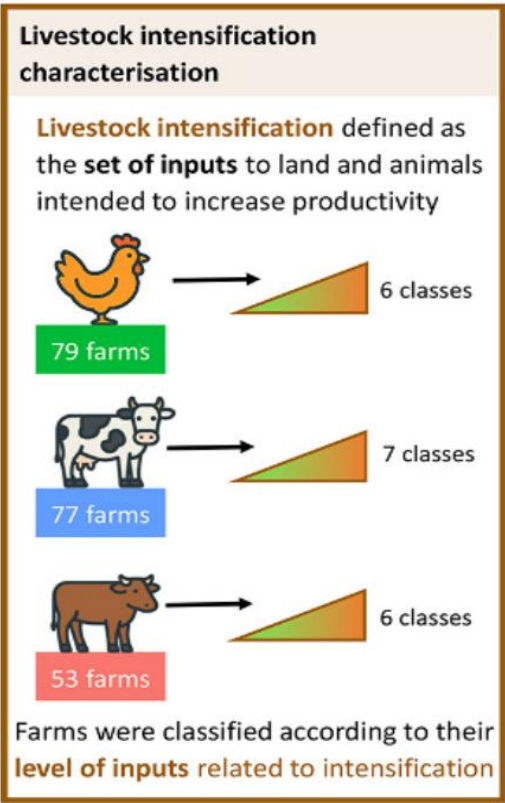


Fig 2: Location of the farms enrolled in the project

Production	Most extensive systems	Most intensive systems
Broilers	5.0	2.8
Dairy	6.3	4.1
Beef	19.2	7.2

Table 1: Gross feed efficiency of productions expressed as kg of feed protein used to produce 1 kg of animal protein. The lower the better,



Four metrics were calculated per farm:

- Productivity:** — kg protein per livestock unit, per ha, per worker
- Feed protein efficiency (gross):** kg feed protein used to produce 1 kg animal protein, all feeds considered
- Feed protein efficiency (net):** same, but only human-edible feed considered
- Land use efficiency:** m² used to produce 1 kg protein, considering all land or only arable land

Net efficiency: the picture reverses in cattle

When only human-edible feed protein and arable land are considered, rankings change dramatically:

In broilers, intensification still mitigates feed-food competition: indoor fast-growing systems require half the resources of outdoor slow-growing systems.

In dairy, net efficiency moves in the opposite direction: low-input grass-based systems require almost no human-edible protein and little arable land ($\approx 10 \text{ m}^2/\text{kg}$), while the most intensive classes require 1.9 kg feed proteins and $\approx 34 \text{ m}^2$ to produce 1 kg of animal protein. Most of the low-input dairy farms were then net producers of human-edible protein,

- Intensification improves productivity, feed efficiency, and land use up to a plateau.
- In broilers, intensification reduces feed-food competition up to a plateau.
- In cattle, intensification exacerbates feed-food competition.
- Strict grass-based cattle systems remain net protein producers whatever the context.

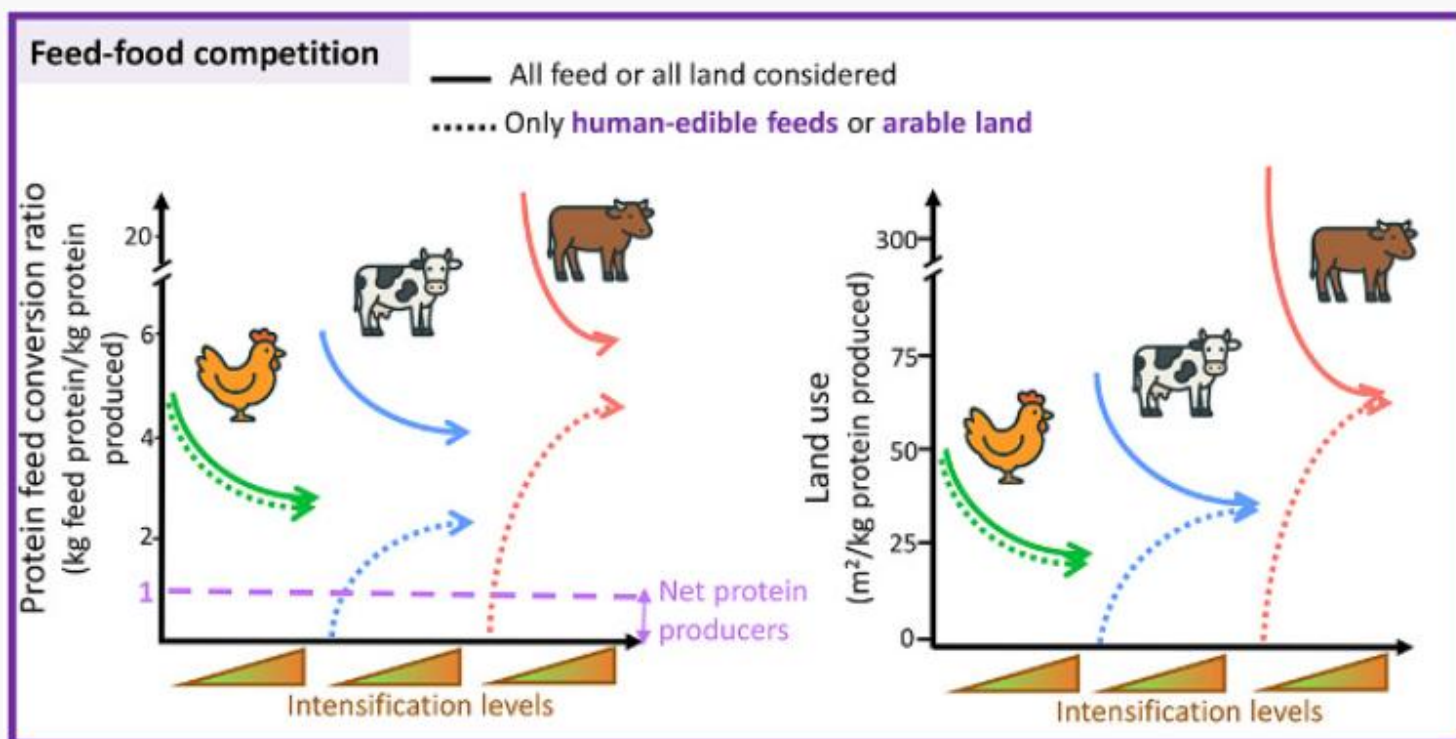


Fig 3. How intensification affects feed-food competition in broilers, dairy and beef systems

In beef, pasture-based low-input suckler and fattening farms require almost no human-edible protein, whereas indoor fattening systems still need 4.6 kg of human edible protein to produce 1 kg of animal proteins.

Across productions, dairy became the most efficient production for human-edible protein followed by beef and broilers.

These findings highlight that strategies to reduce feed-food competition appear species-specific and involve livestock intensification in different ways. Gross efficiency improves with intensification but plateaus and net efficiency worsens in cattle as human-edible inputs increase. Grass-based cattle systems convert non-human-edible resources (grass, permanent grassland unsuitable for cropping) into human-edible food and they can produce more human-edible protein than they consume.

Strategies to reduce feed-food competition are species-specific: reasonably efficient broiler production vs. grass-based dairy and beef systems.



Implications for sustainable livestock systems:

Supporting grass-based dairy and beef systems, alongside reasonably efficient broiler production, could strengthen food-system sustainability and reduce competition for arable land and human-edible resources.

Key messages:

- Intensification is a double-edged sword: it improves gross productivity and efficiency (freeing land) but, in cattle, it increases reliance on human-edible feed and arable land.
- Input-focused farm typologies allow a fair comparison of systems, without circularity between inputs and outputs.
- Feed-food competition is only one aspect of sustainability: environmental (emissions, ecosystem services), economic and social dimensions must also be considered — within-system variability remains large, indicating room for improvement in every system.

Fig. 4 illustration of typical farming systems able to reduce competition for arable land and human-edible resources.

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