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WHAT IS FEED-FOOD COMPETITION?

This piece is a summary of the TABLE Explainer [What is feed-food competition?](#) and aims to define the concept and illuminate key debates. Citations and references for the information discussed below can be found in the full explainer.

An introduction to feed-food competition

The concept of feed-food competition refers to the tensions and trade-offs between two alternative uses for edible crops: direct human consumption, versus feeding them to livestock. The feed-food competition question manifests itself in discussions about desirable end uses for human-edible crops and wild fish, and how best to allocate different land areas to different forms of food production.

Feed-food tensions relate to broader debates about how best to allocate the available labour, capital, and natural resources in the food system. This brings in the concept of opportunity costs – the idea that there will be benefits forgone in choosing any one of multiple, mutually exclusive courses of action. Feed-food competition is fundamentally linked to this concept because it involves weighing up the trade-offs associated with allocating finite resources to producing animal-feed, other non-food products (e.g., biofuel), and food for human consumption. A key argument is that more people could be fed if edible crops were eaten directly and (sometimes) if land used for producing human-inedible crops was instead used to grow human-edible crops.



Included in this summary

An introduction to feed-food competition

Defining feed food competition

What considerations influence judgements about feed-food competition?

Livestock on leftovers: a solution to feed-food competition?





Defining feed food competition

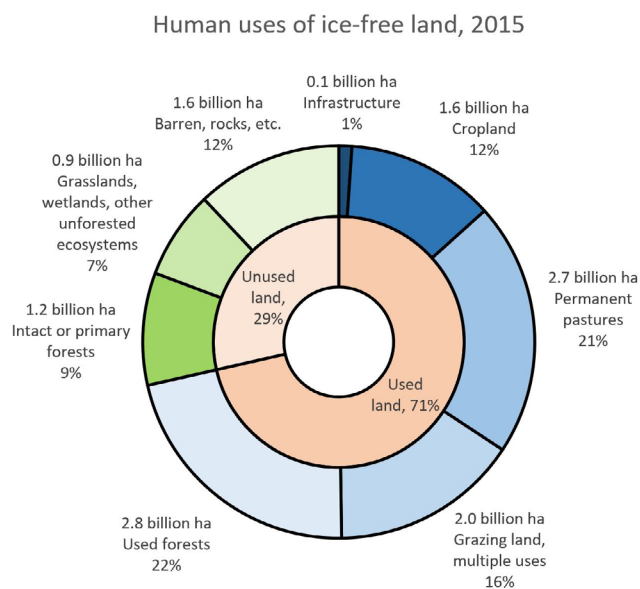
How one defines feed-food competition varies depending on the resource being considered. In this context, the notable resources are human-edible crops, land, and wild fish.

Human-edible crops

Roughly 30% of human-edible crops produced are fed to livestock, which critics argue is inefficient and wasteful. Animals produce fewer calories and **protein** (as animal products) than were present in their feed (a proportion is metabolised, lost via excretion, or forms inedible body parts). Thus, more people could be fed if human-edible crops were eaten directly rather than passing through animals first.

Land

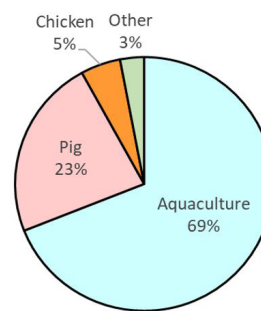
Land is used for many purposes: agriculture, non-agricultural infrastructure, or natural habitats. The **IPCC** estimates that of the 13 billion ha of ice-free land on Earth, between 42-62% is used for agriculture. The extent of direct feed-food competition on agricultural land can be defined as the area of land able to produce crops for direct human consumption, but which currently grows feed-crops or grazes livestock. Under this definition, Mottet *et al.* estimate 1.1 billion ha of land (17% of the IPCC's estimate of total agricultural area) produces livestock when it could produce food crops.



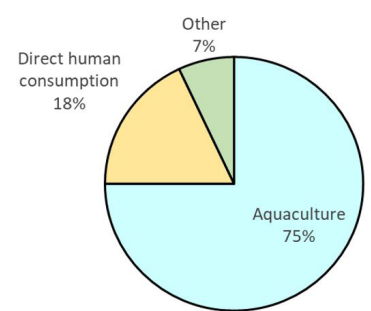
Wild fish

Feed-food competition also applies to human-edible wild-fish being fed to farmed fish or land-based livestock instead of being eaten directly by humans. Currently, over 90% of fish destined for non-food uses (e.g., as **aquaculture** feed) is suitable for human consumption.

Use of fishmeal by market, 2016



Use of fish oil by market, 2016



What considerations influence judgements about feed-food competition?

Decisions over allocating resources to various end-uses are often driven by economics and the profit motive. However, viewed under the broader lens of opportunity costs, other considerations include **food security**, environmental impacts, differing food cultures, and debates around whether to prioritise efficiency or **resilience**. Whilst these considerations are often trumped by profit, they are still important factors in the feed-food competition debate.

Food security

A major concern around feed-food competition is its influence on aspects of food security, including the quantity of human-edible food produced, its nutritional content, and food prices.

Quantity of food produced

Feedlot ruminant systems consume over four times as much human-edible protein as they produce. Thus, using human-edible crops as feed arguably undermines food security because more food would be available if crops were eaten directly by people rather than being used as feed. Cassidy *et al.* estimate that if all edible crops were



consumed directly by humans, global calorie availability would increase by 70% – enough to feed another 4 billion people. Moreover, different animals have different **Feed Conversion Ratios** and require different feed compositions to thrive. For example, redirecting human-edible feed from all meat production to feed-based egg and dairy production would arguably increase global calorie availability by 14% (feeding another 815 million people).

However, some argue that feeding *some* human-edible crops to livestock 'leverages' human-inedible feed consumption and makes net positive contributions to food availability. Van Zanten *et al.* conclude that dairy cows fed a mixture of human-edible and human-inedible feed (e.g., grass from **marginal lands**), produce more human-edible protein than they consume. For further discussion of livestock production efficiency and 'leveraging' see **What is environmental efficiency? And is it sustainable?** and **Lean, green, mean, obscene...? What is efficiency? And is it sustainable?**

Nutrient content

In addition to food quantity, achieving food security requires attention to nutritional value. **Nutrient profiling** models (algorithms for nutrient profiling, also known as nutrient density indices) consider levels of various nutrients in foods to assess their nutritional value. Complex models also account for the wider dietary contexts within which foods are eaten, and factors like their carbon footprint. The models are often used to argue for animal products on the grounds that they are dense in **bioavailable** essential **micronutrients** which can combat growing concerns over **micronutrient deficiencies** (see **What is malnutrition?**) and maintain food security (particularly when obtaining adequate nutrition from plant-source foods is difficult). However, some still question how much (if any) animal source food is needed in human diets (see our **Letterbox Series 4: Vegan or flexitarian – which diet is healthier?**).

Food prices

Feed-food competition also impacts interactions between food prices and food security. Crops are allocated towards feed or food according to changing demand, which then influences food prices. Arguably, using human-edible crops as animal feed may increase demand for those crops. This potentially undermines food security by increasing their price and excluding poorer people from staple crops often linked to feed-food competition (like grains).

However, Manceron *et al.* find that feed-food competition has *decreased* over the last few decades: the share of cropland producing animal feed decreased from roughly 45-50% in the 1970s to 35-39% in 2009. This suggests that feeding crops to livestock is only possible due to surplus created by improved crop productivity. Furthermore, the argument that using human-edible crops as feed reduces food available is not necessarily true – reduced demand for animal feed might lower production of those crops meaning they are no longer available for human consumption.

Environmental impacts

Opportunity costs also apply to wider environmental impacts of feed-food competition (**biodiversity** loss, climate change, etc). Di Paola *et al.* compared protein production from plants and crop-fed livestock. Plant protein production used 2.4-33 times less land and water and produced 2.4-240 times fewer greenhouse gas emissions. Here, crop-fed livestock appears environmentally inefficient suggesting that plant-based foods are preferable to crop-fed animal products.

Theoretically, habitat destruction and carbon emissions from expanding farmland into natural **ecosystems** would decrease if human-edible crops were fed to people rather than livestock. However, shifting diets from consuming livestock reared in intensive grain-fed systems to those in grazing systems may offset positive changes. This could result in more land than necessary being used to produce similar amounts of animal products (see **What is the land sparing-sharing continuum?**) in the absence of consumption shifts. However, **regenerative grazing** proponents argue grazing systems maximise **carbon sequestration**, biodiversity and soil health compared to **intensive agriculture**. In contrast, organisations like the Vegan Organic Network, suggest that livestock is unnecessary in **regenerative agriculture**.

Societal value

Feed-food competition also relates to discussions about what we need versus what we want. Luxury crops (e.g., coffee or wine-making grapes) can be seen to use land/resources that could otherwise produce more socially 'worthwhile' outcomes like conservation or more nutritious foods. Some commercial crops – such as alcohol crops and sugar – are also detrimental to health. Crop quality is another consideration. For example, UK feed-grade



wheat has a lower protein/gluten content than food-grade wheat used to make the light, airy bread valued by consumers. The perceived value of different crops will depend on personal values and societal norms (dietary preferences, the value of health, pleasure, livelihoods, etc) as well as economic considerations.

Free market advocates argue that the mechanism of price automatically optimises food supply to maximise societal value (defined by individual purchasing choices) revealing peoples' preferences. However, critics argue (for example) that richer people often disproportionately influence what is produced, potentially causing free markets to prioritise expensive luxuries (such as grain-fed meat often favoured by higher-income countries) over necessities for poorer people.

Efficiency vs resilience

Using edible crops as livestock feed may be inefficient in terms of people nourished per hectare or unit of environmental impact. However, it arguably increases the food system resilience to economic or ecological shocks by maintaining crop production above minimum levels needed to feed people. See also "Food waste as a buffer against food insecurity" in **What is food loss and food waste?**

Proponents of regenerative or **agroecological** systems argue that reducing feed-food competition does not eliminate the perceived harmful effects of intensive cropping (such as fossil fuel reliance). Conversely, increasing crop yields (e.g., via **sustainable intensification**) could arguably improve food system resilience by creating more **biomass** for all end-uses, thus reducing feed-food competition.

Livestock on leftovers: a solution to feed-food competition?

'**Livestock on leftovers**' is a proposed system to minimise feed-food competition, without eliminating animal agriculture altogether. The idea is that livestock eat only human-inedible feedstuffs (grass, food waste, waste biomass from industry, etc), recycling otherwise inedible biomass back into the food system, obtaining nutrient-dense food in the process. This approach is estimated to produce between 9g and 31g of animal protein per person per day (excluding fish) depending on allocation

of leftovers to different livestock systems. Whilst not meeting projected increased demand for animal products, proponents state it would still make useful contributions in the context of global shifts towards rebalanced meat and dairy consumption (especially, lower intakes in the Global North).

Röös *et al.* find that, relative to business as usual, livestock on leftovers would reduce greenhouse gas emissions by around 40%. Notably, a purely vegan scenario would further reduce emissions (by 73%) by avoiding methane emissions from livestock. However, having reviewed several studies, Van Zanten *et al.* conclude that livestock on leftovers could use one quarter less **arable land** globally, than purely vegan diets. Nevertheless, this scenario would still use large land areas for **pasture**, potentially limiting conservation of certain ecosystems and driving continued **deforestation**. Additionally, if animal product consumption exceeded the amount provided by livestock on leftovers, then feed-food competition would continue.

Conclusion

Feed-food competition provides a starting point for discussing inequality, sustainability, and wider impacts of the food system. Some state that using edible crops as animal feed, rather than feeding people directly, reduces food security and is environmentally detrimental. Here, they posit 'livestock on leftovers' as a partial solution, or alternatively shifting to entirely plant-based diets. Others argue that feeding human-edible crops to livestock makes use of plentiful grain, incentivises productivity gains, contributes to resilience, uses less land than grazing systems, and produces tasty nutrient-dense foods. Overall, feed-food competition exposes wider food systems debates over how food should be produced, what we should eat, and what role (if any) livestock should play.

The full report (with associated citations and references) is available at: <https://www.tabledebates.org/building-blocks/what-feed-food-competition>