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More fuel for the food/feed debate

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In 2050, the world will count 9.6 billion people, 70% living in cities with an average income almost twice as high as today. As a result, global demand for animal products will continue to grow and play a critical role in global food security and nutrition. But livestock use a large share of agricultural land and are often considered a resource drain. Particularly criticized is the low efficiency of livestock to convert feed into human edible protein and the competition for the use of cereals as livestock feed or for direct human food.

Food from animal sources contributes 18% of global calories consumption and 25% of global protein consumption (FAOSTAT, 2016). But it also makes an important contribution to food security through the provision of high-quality protein and a variety of micronutrients, e.g. vitamin A, vitamin B-12, riboflavin, calcium, iron and zinc that can be locally difficult to obtain in adequate quantities from plant-source foods alone (Randolph et al., 2007; Murphy and Allen, 2003). Livestock's contribution goes beyond the production of meat, milk and eggs, and a number of factors determine their overall impact on food security (Gerber et al., 2015). Positive contributions include: (1) the direct supply of essential macro- and micro-nutrients; (2) the contribution of domesticated animals to agricultural productivity through manure and draught power; and (3) the income generated by livestock production at household and national level. Potentially negative contributions to food security include: (1) animal feed rations containing resources that can also serve as human food; (2) the fact that animal feed may be produced on land suitable for human food production; and (3) the relatively low efficiency of animals in converting feed into human-edible products.

A study led by FAO and published in Global Food Security aims to inform the debate on the contribution of animal production to food security (Mottet et al., 2017). The methodology relies first on a feed classification that considers whether each feed material is edible or produced on a land that could be used to grow human-edible plants (Figure 1).

Efficiencies are expressed in Feed Conversion Ratios (FCR), the quantity of feed required per unit of output (milk, meat or eggs). Three different FCRs are considered: FCR1 [kg dry matter (DM) intake/kg protein product], FCR2 (kg DM human-edible feed material/kg protein product) and FCR3 (kg of human-edible feed and soybean cakes/kg protein output). In addition protein-FCR considered the feed protein intake and meat-FCR considered the meat output only.

The livestock production systems and estimates of feed rations were obtained from the FAO Global Livestock Environmental Assessment Model (GLEAM, Gerber et al., 2013), a spatially explicit model that represents bio-physical processes and activities along livestock supply chains under a life cycle assessment

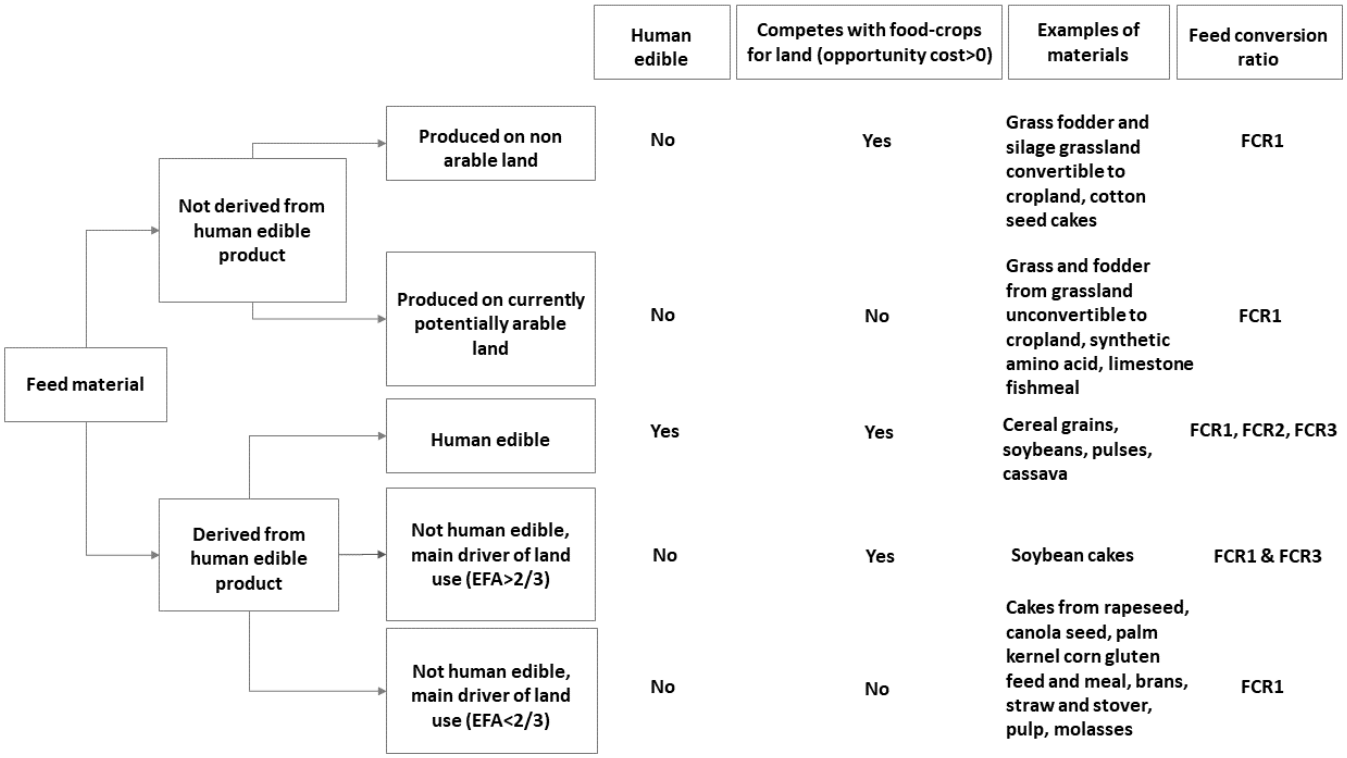


Figure 1: Feed classification methodology

(LCA) approach. GLEAM has a high level of quantitative detail on herd production functions and resource flows, and relies on a farming system typology that includes the feed-base and the agro-ecological conditions, adapted from the classification principles of Seré and Steinfeld (1996). GLEAM includes six species of livestock - cattle, buffalo, sheep, goats, pigs and chickens. Ruminant production is differentiated into feedlot (for beef only), mixed and grazing systems; pig production into backyard, intermediate and industrial systems and chicken production into backyard, layers and broilers.

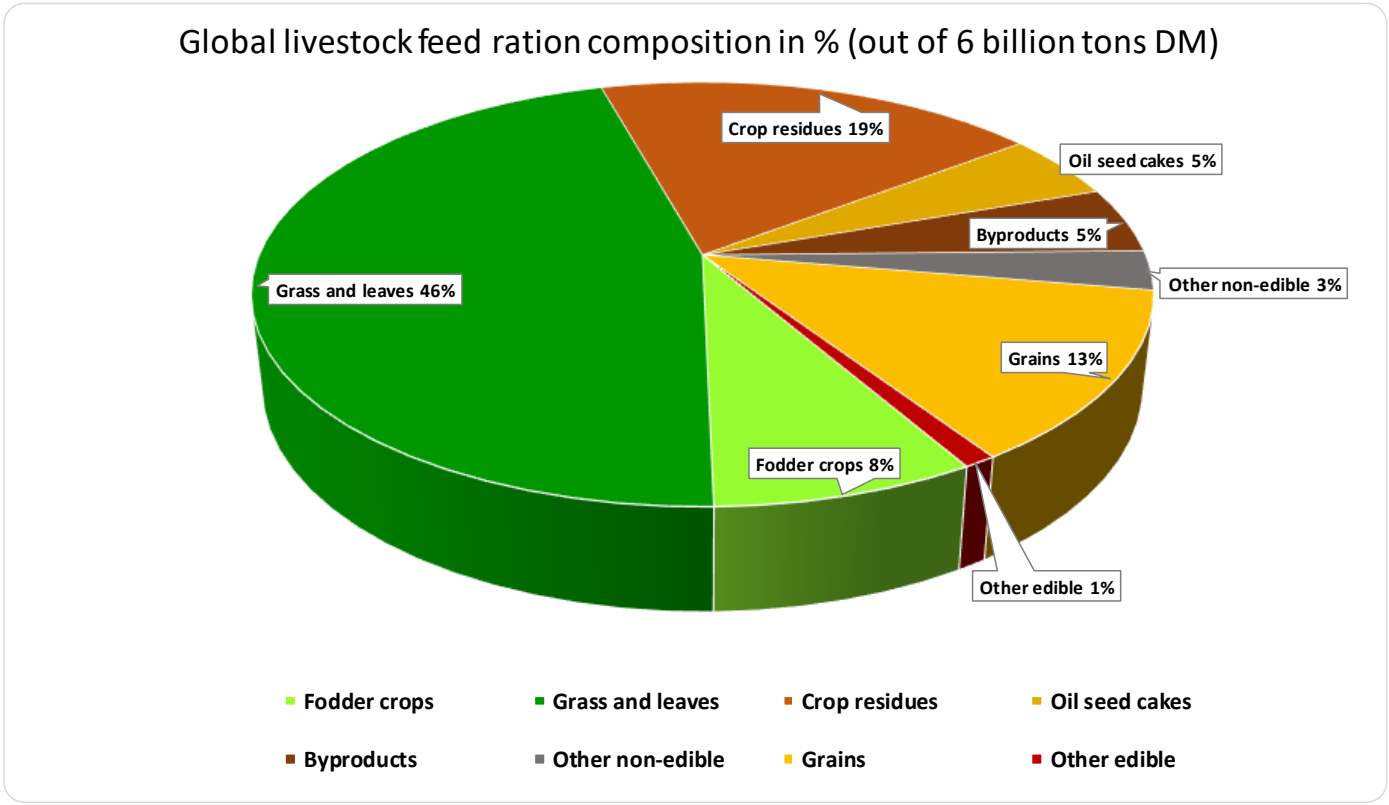
Land used for forage and feed production was derived from the Global Agro-Ecological Zones, GAEZ 3 (IIASA/FAO, 2012). A yield gap between actual and potential production was used to map grassland potentially convertible to arable lands and ones unsuitable for crop production.

Finally, a study by Wirsenius et al. (2010) was used as a reference to estimate potential improvements in Feed Conversion Ratios. The OECD/FAO Agricultural Outlook for 2016-2025 (OECD/FAO, 2016) was used to analyse future trends in the livestock sector and their implications for feed demand and land-use, as compared with the reference year 2010.

The study shows that feed rations are very diverse across production systems and regions, and that 86% of livestock feed is not suitable for human consumption (Figure 2). If not consumed by livestock, feed material such as crop residues and by-products of the food industry could quickly become an environmental burden as the human population grows and consumes more and more processed food.

Results also show that livestock consume food that could be eaten by people. Grains account for 13% of the global livestock dry matter intake, which represents about one-third of global cereal production.

While ruminants need on average 133 kg of DM to produce 1 kg of protein (Table 1), they only need 6 kg of human-edible DM and 0.6 kg of human-edible feed protein to produce 1 kg of animal protein. Contrary to often reported estimates, this study found that an average of only 3 kg of cereals are needed to produce 1 kg of meat at global level. It also shows important



Fodder crops: grain and legume silages, fodder beets. Crop residues: straws and stover, sugarcane tops, banana stems. By-products: brans, corn gluten meal and feed, molasses, beetroot pulp and spent breweries, distilleries, biofuel grains. Other non-edible: second grade cereals, swill, fish meal, synthetic amino acids, lime. Other edible: cassava pellets, beans and soy beans, rapeseed and soy oil.

Figure 2: Global livestock feed ration composition (source: GLEAM 2.0)

	Protein	FCR 1	FCR 2	Meat-FCR 2	FCR 3	Protein FCR 2
	Million tons/year	Kg DM /kg protein	Kg edible DM /kg protein	Kg edible DM /kg meat	Kg compete DM /kg protein	Kg edible protein/ kg protein
Ruminants	36,355	133	6	2.8	6.7	0.6
Monogastrics	38,246	30	16	3.2	20.3	2.0
All	74,601	80	12	3.1	13.7	1.3

Table 1: Global Feed Conversion Ratios

differences between production systems and species. For example, because cattle rely on grazing and forages, they need only 0.6 kg of protein from human -edible feed to produce 1 kg of protein in milk and meat, which is of higher nutritional quality than the plant proteins. Cattle thus contribute directly to global food security.

The study also investigated the type of land used to produce livestock feed. Results show that out of the 2.5 billion ha needed, 77% are grasslands, with a large share of pastures that couldn't be converted to croplands and therefore could only be used for grazing animals.

FAO estimates that we need 70% more animal

products by 2050 to feed the world. Therefore, the area of land needed to raise animals will also increase if Feed Conversion Ratios (FCR) are not further improved. Results show that modest improvements of FCR can prevent further expansion of arable land dedicated to feed production.

Steps have already been taken through feed formulation, genetic selection, and better veterinary services to improve FCRs over the last 30 years. An improved (more efficient) feed conversion also reduces livestock's environmental footprint, but continued progress is needed to make the system more sustainable. In addition, it is essential to improve the recycling of food wastes and by-products into livestock feed as well as to increase feed crop yields.

"Animal production, in its many forms, plays an integral role in the food system, by making use of marginal lands, turning human-inedible products and co-products into human-edible goods, contributing to crop productivity and turning human-edible crops as well as human-inedible products into highly nutritious, protein-rich food. In order to assess how to sustainably feed 9.6 billion people in 2050, quantifying the land and biomass resources used in livestock production and the food output they generate is a basic requirement. But we also need to improve our modelling capacity by including trends in consumer preferences, shifts in animal species, climate change impacts, and industrial processes to improve the human edibility of certain feed materials (Mottet et al., 2017)".

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