POSITION PAPER

Livestock and Climate Change: what are the options?

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1 The tension around livestock

Our food and agriculture systems are both broken. On the food side: hunger, food insecurity and malnutrition are making a resurgence, while excess weight, obesity and diet-related diseases have become a global epidemic (FAO, IFAD, UNICEF, WFP, and WHO, 2019). On the agriculture side: growing resource depletion and rapidly accelerating environmental degradation are breaching planetary boundaries (Rockström et al., 2009; Steffen et al., 2015), most notably in the form of climate change (IPCC, 2019).

Livestock systems, in particular, have been singled out as a major driver of environmental change (FAO, 2006). Specifically, ruminant grazing systems play a major role in land and biomass use (Gerber et al., 2013). The majority of human appropriation of net primary production (HANPP) goes to livestock (Haberl et al., 2007). The sector is responsible for around 2/3 of emissions from agriculture and land use (FAOSTAT, 2016). It uses 80 % of agricultural land, most of which is pasture but around 30 % of total arable land is used for feed production (Mottet et al., 2017). Through habitat occupation and change (Leadley et al., 2010; Mitloehner, 2010), the sector affects biodiversity in numerous direct and indirect ways (Dise et al., 2011; Bobbink et al., 2010). It draws heavily on nutrients: consuming around 65 Tg of nitrogen (Uwizeye, 2019) and some 111,000 km^3 (approximately 10 %) of annual global water flows (Deutsch et al., 2010). Animals are also involved in the emergence and spread of diseases affecting human health (SOFA, 2009).

Currently, a total of six billion metric tons of biomass (dry matter) is needed annually for farmed animals to live and grow (Mottet et al., 2017). Around 3/4 are roughage, made up of grass, leaves, crop residues and cultivated fodder. Grains are responsible for around 13 % of total feed consumption but account for one third of all cereals cultivated – a share that continues to grow (Mottet et al., 2017). Oilseed rape and its by-products make up the rest.

Current projections indicate a continued growth in demand for meat, milk and eggs, driven by population and income growth in low and middle income countries (OECD/FAO, 2019). Livestock systems are dynamic and are engaged in rapid structural change. Productivity growth results from intensification associated with an increased use of concentrate feed, a shift from ruminants to monogastrics (poultry in particular), growing volumes of production and processing, and strong vertical integration. Livestock production has become more geographically concentrated in areas with good access to feed and urban markets. Trade in feed and livestock has grown, implying large volumes of transferred resources and emissions. There are significant regional differences, with increases in demand and future transformation likely to be most prominent in Africa, where demand is projected to triple by 2050 (FAO, 2017).

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2 Emissions and livestock

The transformation of feed into livestock products is associated with direct and indirect emissions of greenhouse gases (GHG), amounting to 7.1 Gt of CO_2eq annually, which equates to around 14.5 % of all anthropogenic emissions (Gerber et al., 2013). Direct emissions are produced from the animal and are associated with biological processes such as enteric fermentation as well as manure and urine excretion. Ruminants produce large amounts of methane – a short-lived climate gas – through enteric fermentation. Methane and N_2O emissions are produced via the nitrification/denitrification of manure and urine. Indirect emissions come from the production of fertiliser for feed production (CO_2), feed production itself (CO_2 and N_2O), manure storage and application (N_2O and CH_4), as well as the processing and transportation of feed, animals and livestock products (CO_2). Comparisons within the system point to large variations in production efficiency and, therefore, to considerable potential for emission reductions through the adoption of best practices.

Emission intensities vary widely among different livestock species and foods. On average, they are highest for ruminant products, especially beef and small ruminant meat (295 and 201 kg of CO_2eq per kg of protein). Cattle milk stands at 86 kg. Emission intensities are lowest for poultry products (eggs at 31 kg and poultry meat at 35 kg) and somewhat higher for pork at 55 kg of CO_2 eq per kg of protein (Gerber et al., 2013).

The scale of the emissions and the abatement potential have drawn livestock, and meat in particular, into the climate debate. On an international level, that debate must take into account the role that livestock play in food security and for the poor. They provide nutritious and appetising food, and play a key role in many rural economies. Livestock are an important buffer in local and national food systems, represent the largest asset for many farmers, and are vital for the poor in rural communities. They provide income and employment, fertiliser (manure), energy (biogas and traction) and other products such as leather, hair and wool. Livestock feature prominently in various cultures and are part of many cultural identities.

The debate also needs to be held in the context of maintaining a healthy diet. Eating habits are changing worldwide, often for the worse, and obesity and diet-related diseases have become global public health concerns, heavily impacting human lives at high costs. Dietary requirements differ a great deal between individuals and population groups. Animal food products convey distinct nutritional advantages to humans because of the quality and availability of key nutrients.

3 What can be done

How, then, can livestock and climate change be reconciled? There are four major ways of alleviating this conflict: increasing efficiency at all levels, creating offsets and other environmental benefits, recycling nutrients and energy, and seeking alternatives across the spectrum.

Firstly, the ongoing process of increasing productivity in livestock systems makes resource use more efficient. In many parts of the world, technological innovations – such as improved feeding, genetics, animal health and information technology – and organisational innovations are driving up productivity and reducing resource use and environmental impact, relative to the amount of livestock produced. There is also considerable scope for greater efficiency in fertiliser production, by using renewable energy, for example, and in its application in feed production, through precision application for instance. This productivity growth has mostly been in response to increasing demand rather than any climate considerations. However, the intensification process could be steered towards low emissions if the appropriate incentives were set. For example, productivity is still stubbornly low in large parts of Sub-Saharan Africa, Latin America and South Asia. It is low because their systems serve purposes other than production, such as asset building in the form of stock (as in Africa and South Asia), or through rising land prices (as in Latin America). In these cases, policies are required that encourage efficiency and better agro-ecological integration, and discourage the keeping of animals for asset accumulation. Extensive, labour-intensive livestock systems with low productivity, prevalent in many low and middle-income countries, are obvious targets for low carbon investments (Mitloehner, 2010).

Secondly, regenerative forms of grazing can generate carbon offsets and other environmental benefits. Well-adapted grazing systems with improved pasture and optimised grazing regimes have the potential to stimulate plant growth and capture soil carbon, particularly in areas where degradation is not yet severe. In particular, the introduction of trees in tropical pastures on previously forested land (silvo-pastoralism) and other forms of agro-ecology (Bonaudo et al., 2014) can help to stabilise productivity and generate multiple social and environmental benefits. Whilst the potential for carbon sequestration and the permanence of such capturing methods are still subject to much debate, the extent of pasture degradation and loss of productivity is such that urgent action is required even if large carbon gains may not be realised in the short term. Regenerative grazing can also contribute to improved biodiversity and water efficiency. Such positive externalities need to be recognised through payments for environmental services. At the same time, slowing down and reversing the expansion of pastures into forests remains the most effective way for grazing systems to contribute to mitigation. The same applies to forest clearance for producing feed crops.

Thirdly, emissions can be reduced by reverting to one of the original reasons for keeping livestock: recycling nutrients and energy. Traditional links between livestock and arable farming have become increasingly severed over the course of intensification, and livestock operations have become concentrated in areas with limited arable land on which to apply manure. This disrupts nutrient cycles and creates depletion upstream as well as excesses downstream. Cycles can operate on various levels, for instance, within farms, on the watershed level or globally. While there are considerable differences in recycling practices, large amounts of potential feed such as crop residues, agro-industrial by-products and food waste are unused, often with direct adverse environmental impact as well as a loss of opportunity for recycling. Similarly, only a fraction of the nutrients contained in animal waste are returned to the land in a useful way. A combination of regulations and spatial planning is required to create opportunities and incentives for recycling, which will reduce the impact on our climate.

Fourthly, there are alternative paths to the one which depends on conventional feed and livestock. Bio-technological innovations are revolutionising the way protein can be produced and used. This includes established practices such as the use of synthetic amino acids, novel techniques involving algal, fungal and microbial proteins, replacing conventional feed protein such as soy, and making its use more efficient. The use of insects has also been growing, both for feed and food.

There is a rapidly growing interest in substitutes for livestock products. Most of them are plant-based imitations of the original product, however, there is a rapidly growing field of application in microbial protein. While their actual environmental impact varies, there can be little doubt that low-carbon alternatives to today's livestock products can be developed rapidly, given the massive start-up investments that are taking place. Plant-based alternatives also appeal to concerns around animal welfare and healthy diets. Efforts are also underway to generate synthetic meat through cellular agriculture based on stem cells. Policies that discourage the consumption of high-emission food products, such as beef, through awareness-building and taxation are also being considered.

Each of these approaches has considerable potential to reduce livestock emissions, and they will be even more powerful in combination, with different approaches being more relevant to different social contexts and food systems.

4 Time to act

Livestock play a large role in natural resource use, and, as such, have taken centre stage in the climate change debate as an obvious target for mitigation. The pressure to reduce emissions will only increase, fuelled by consumer concerns around diet, health and animals. Plant-based alternatives have recently seen a rapid upsurge. Livestock systems will have to adapt, not only to climate change and market demands, but also as a result of upcoming policy changes aimed at low-cost mitigation options. It is only a matter of time before livestock become a direct target of climate change policies.

Ruminant systems, particularly beef, are being challenged the most. Research is underway to reduce enteric methane emissions by manipulating the rumen flora, however, related techniques are not yet practical or cost-effective. For now, the only way to substantially reduce emissions is through offsets from afforestation and soil carbon.

Climate change calls the place of livestock in food and agriculture into question. Finding that place, and renewing the license to operate, is urgent. Such efforts need to be built on transparency and a consensus on methods for measuring emissions and tracking progress. Pricing and regulations must encourage best practice and responsible consumption. Engagement from all stakeholders is required in conjunction with local solutions to tap the potential of livestock systems and contribute to climate action.

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